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(54) Multiple code camera system

Kameralesevorrichtung für verschiedene Codes

Système de lecture par caméra pour codes multiples

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(56) References cited:
EP-A- 0 115 558 EP-A- 0 159 608
FR-A- 1 578 217 US-A- 4 408 344
US-A- 4 896 029

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Description

[0001] The invention relates to an optical target acquisition system and method. The invention may be, or may be applicable to, a camera system for optically scanning moving objects to obtain optically encoded information from the surface of the objects.

[0002] Merchandise, various component parts, letters, moving objects, containers and a whole gamut of related items being shipped or transported, frequently must be identified with information regarding origin, flight number, destination, name, price, part number and numerous other kinds of information. In other applications, the reading of encoded information printed on labels affixed to such items permits automation of sales figures and inventory as well as the operation of electronic cash registers. Other applications for such encoded labels include the automated routing and sorting of mail, parcels, baggage, and the like, and the placing of labels bearing manufacturing instructions on raw materials or component parts in a manufacturing process. Labels for these types of articles are conventionally marked with bar codes, one of which is the Universal Product Code. Numerous other bar code systems are also known in the art.

[0003] However, certain applications require the encoding of larger amounts of information on labels of increasingly smaller size. Commercially-available bar code systems sometimes lack sufficient data density to accommodate these needs. Attempts to reduce the overall size and spacing of bars in various bar code systems in order to increase data density have not solved the problem. Optical scanners having sufficient resolution to detect bar codes comprising contrasting bars spaced five mils (1 mil = 1/1000 inch; 1 inch = 2.54 cm) or less apart are generally not economically feasible to manufacture because of the close tolerances inherent in the label printing process and the sophisticated optical apparatus required to resolve bit-encoded bars of these dimensions. Alternatively, to accommodate increased amounts of data, very large bar code labels have been fabricated, with the result that such labels are not compact enough to fit on small articles. Another important factor is the cost of the label medium, such as paper. A small label has smaller paper costs than a large label. This cost is an important factor in large volume operations.

[0004] Therefore, other types of codes have been investigated to overcome the problems associated with bar codes. Some alternatives to bar codes are: circular formats using radially disposed wedged-shaped coded elements, such as those disclosed in U.S. Patent No. 3,553,438, issued to Blitz, and entitled "Mark Sensing System", or concentric black and white bit-encoded rings, such as in U.S. Patent Nos. 3,971,917 and 3,916,160, issued to Maddox and Russo, respectively; grids of rows and columns of data-encoded squares or rectangles, such as in U.S. Patent No. 4,286,146, enti-

tled "Coded Label and Code Reader for the Coded Label," issued to Uno; microscopic spots disposed in cells forming a regularly spaced grid, as disclosed in U.S. Patent No. 4,634,850, entitled "Quad Density Optical Data System", issued to Pierce; and densely packed multicolored data fields of dots or elements, such as those described in U.S. Patent No. 4,488,679, entitled "Code and Reading System," issued to Bockholt.

[0005] These codes were satisfactory for many applications. However, some of the encoding systems described in the foregoing examples and other encoding systems known in the art still did not provide the required data density. For example the encoded circular patterns and grids of rectangular or square boxes did not provide sufficient density. Alternatively, in the case of the grids comprised of microscopic spots or multi-colored elements referred to above, such systems require special orientation and transport means, thus limiting the utility to highly controlled reading environments. A further improvement, U.S. Patent No. 4,874,936, entitled "Hexagonal Information Encoding Article, Process and System," issued to Chandler discloses a label for storing information-encoded hexagons which stores densely packed information and may be read at high speed in any direction. This improvement thus solves the data density problems associated with bar codes.

[0006] However, the newer encoding systems, including the encoding system taught by Chandler, are of formats which are entirely different from conventional bar codes and can not be read by conventional bar code readers. Therefore it is difficult to use the newer encoding methods which may solve the data density problems of bar codes in an environment in which bar codes are also present unless separate scanning and decoding equipment is provided for each type of code. Thus, it would be advantageous to have a single scanning and decoding device which may detect and decode different types of encoding systems when the different encoding systems are alternately disposed in the range of the optical scanning and decoding device. Additionally, when higher density codes are used, higher resolution optical scanning and therefore higher levels of illumination are required. However, the very high levels of illumination are only required some of the time. Thus energy is wasted and a threat of eye injury is needlessly created during the remaining periods.

[0007] Regardless of the type of encoding system used, high quality detection is required in many applications. Modern conveyor systems may have conveyor belt widths of three to four feet (1 foot = 12 inches; 1 inch = 2.54 cm) over which the position of an information-encoded label may be disposed and belt speeds of five hundred feet per minute or more. They carry moving objects which may be of varying heights upon which information-encoded labels are disposed. Thus, it can be very difficult for optical decoding systems to locate and read the data encoded labels disposed on these rapidly moving objects.

[0008] These problems have led to the need for providing a simple, rapid and low-cost means of signaling the presence of a data-encoded label within the field of view of an optical scanner mounted in a manner to permit scanning the entire conveyor belt. It is known in the art to solve these problems by providing easily recognizable optical acquisition targets as part of an encoding system. For example, the system taught by Chandler uses a concentric ring acquisition target for this purpose.

[0009] Bar code systems may also be understood to provide an acquisition target. For example, it is conventional in the art of detecting bar codes to pre-detect the rectangular shape formed by the bars. In this type of system a rectangle may indicate the presence of a bar code. Conventional bar code detectors, after acquiring the rectangle, then attempt to find encoded data within the pre-detected rectangle. If valid data is found encoded within the rectangle, the bar code is thus detected. However, many other types of rectangles within the range of the optical scanning device may cause false pre-detects in this method.

[0010] Further data arrays having acquisition targets other than the concentric rings and bar codes are known in the art. For example, concentric geometric figures other than rings, such as squares, triangles, hexagons and numerous variations thereof, are described in U.S. Patent No. 3,513,320, issued to Weldon, on May 19, 1970, and entitled "Article Identification System Detecting Plurality of Colors Disposed on an Article", and U.S. Patent No. 3,603,728, issued to Arimura, on September 7, 1979, and entitled "Position and Direction Detecting System Using Patterns". U.S. Patent No. 3,693,154, issued to Kubo et al., on September 19, 1972, and entitled "Method For Detecting the Position and Direction of a Fine Object", and U.S. Patent No. 3,801,775, issued to Acker, on April 2, 1974, and entitled "Method and Apparatus for Identifying Objects" also describe systems using symbols comprising concentric circles as identification and position indicators, which symbols are affixed to articles to be optically scanned.

[0011] U.S. Patent No. 3,553,438, entitled "Mark Sensing System", issued to Melvin, discloses a circular data array having a centrally-located acquisition target comprising a number of concentric circles. The acquisition target of Melvin provides an image which may be used by an optical scanning device to locate the label. The acquisition target of Melvin also permits determination of the geometric center of the label and the geometric center of the data array. This is done through logic circuitry which recognizes the pulse pattern representative of the concentric ring configuration.

[0012] The foregoing systems are generally scanned with an optical sensor capable of generating a video signal output. The video output signal corresponds to the change in intensity of light reflected off the data array and is therefore representative of the position and orientation of the scanned symbols. The video output of

such systems, after it is digitized, has a particular bit pattern which may be matched to a predetermined bit pattern. A common bit pattern of this type is a simple harmonic as in the system taught by Chandler.

[0013] It is well known to detect the presence of harmonics such as those produced by these systems in both the digital and the analog domains. However, in high speed optical systems for acquiring digital data the recognition of the target must take place in much less time than is available to recognize, for example, the touch tone of a telephone. Thus, a system for detecting any of these codes must reliably identify the harmonics caused by an optical scan of a common optical acquisition target from a signal which lasts only as long as the acquisition target is actually scanned.

[0014] As previously described, Chandler discloses a circular data array having a centrally located acquisition target comprising a series of concentric rings which produces a harmonic scan output signal. The acquisition target of Chandler provides a means of acquiring the circular label by the optical sensor and determining its geometric center and thereby the geometric center of the surrounding data array. This is done through logic circuitry which operates to recognize the pulse pattern representative of the concentric ring configuration of the acquisition target.

[0015] This recognition method relies upon a one dimensional scan of the concentric ring pattern. When the concentric ring acquisition target is advanced by a conveyor belt to the scan line of the optical scanning equipment, the scan line eventually passes through the center of the concentric rings. At that point, the harmonic scan output signal is provided at the output of the optical scanning device. This harmonic scan signal is then detected by a correlation filter. Alternately it may be detected by any other type of harmonic detection device. However, this system is subject to some false detects since other objects scanned by the optical scanning device may also provide an harmonic signal at substantially the same frequency as the concentric ring acquisition target. Another system teaching concentric ring detector of this nature is taught by Shaw in U.S. Patent Application Serial No. 07/728,219, filed July 11, 1991 which corresponds to WO-A-9 301 566 published on 21.01.1993.

[0016] The system set forth in Chandler solves many of the problems of the prior art systems by providing very high data density as well as a reliable system for target acquisition. However, in addition to the problem of false detects due to the one-dimensional scan, a relatively high resolution scanning of this label is required in order to acquire the target as well as to decode the high density data. An optical scanning system capable of scanning the higher density data of the codes which solves the density problems of bar codes may therefore be more complex and costly than a system which is adapted to merely acquire a low resolution target.

[0017] Thus it is often necessary for optical scanning systems to acquire a target under very difficult circum-

stances. The target acquired may appear at different locations within the scanning field and may be moving rapidly. In addition to these problems the acquisition target may be disposed at varying distances from the optical scanning device. For example, labels on moving objects may be scanned at varying distances from the scanning device because of varying package sizes. This introduces magnification into the sampled sequence acquisition target. The closer the acquisition target is to the scanning device, the larger it appears and the lower the frequency of the sampled sequence. Larger scanning distances produce higher frequencies. Detection of the varying frequencies caused by varying amounts of magnification can be difficult since digital filters with adjustable poles and zeros may be expensive and complicated. Additionally the varying distance introduces the need for focusing in order to accurately scan the acquisition target.

[0018] There are two common solutions to these problems known in the prior art. One common solution to the focusing problem known in the prior art is using a depth of focus sufficient to permit detection of acquisition targets at varying distances from the optical scanning device. Another common solution to the magnification problem is fixing the distance between the optical scanning device and the acquisition target in order to prevent magnification.

[0019] Prior art references teaching the use of a large depth of focus in order to avoid focusing problems include: U.S. Patent No. 4,544,064, entitled "Distribution Installation for Moving Piece Goods", issued to Felder; U.S. Patent No. 3,801,775, entitled "Method and Apparatus for Identifying Objects", issued to Acker; U.S. Patent No. 3,550,770, entitled "Method for Automatic Sorting or Recording of Objects and Apparatus for carrying Out the Method", issued to Lund; and U.S. Patent No. 4,454,610, entitled "Methods and Apparatus for the Automatic Classification of Patterns", issued to Sziklai.

[0020] One example of a reference teaching a fixed distance between the acquisition target and the optical scanning device includes: U.S. Patent No. 3,971,917, entitled "Labels and Label Readers", issued to Maddox et al. Another reference teaching this is U.S. Patent No. 3,757,090, entitled "Mechanical Reading and Recognition of Information Displayed on Information Carriers", issued to Haefeli, et al.

[0021] A solution to both the focusing problem and the magnification problem is adjusting the distance between the acquisition target and the optical scanning device. U.S. Patent No. 4,776,464, issued to Miller, teaches this type of adjustment. However, this method is mechanically difficult for a large number of quickly moving and closely spaced moving objects of widely varying heights. Additionally, the system taught by Shaw in U.S. Patent Application Serial No. 07/728,219 (WO-A-9 301,566) teaches a similar solution to this problem.

[0022] US Patent No. 4 408 344 discloses a hand held optical OCR and bar code reader using a multiport ma-

trix array. The reader comprises a processor 1 for OCR and a processor 2 for bar code reading.

[0023] It is the object of the invention to provide a rapid and low cost means for signaling the presence of a data-encoded label within the field of view of an optical scanner.

[0024] This object is solved in accordance with the features of the independent claims. Dependent claims are directed to preferred embodiments of the invention.

[0025] A multiple code camera system may simultaneously search for a number of different optical codes. Upon detecting an optical code it decodes according to the appropriate decoding algorithm. These codes may include information-encoded polygons, differing bar codes, and optical character recognition codes. The multiple code camera system is provided with a parallel decoding architecture which allows it to search for several codes simultaneously. The system is interconnected with two different data buses which facilitate the parallel operation. These two buses are: (1) a system bus linking the components of the multiple code camera system, and (2) a pixel bus connecting an analog-to-digital converter from the optical scanning device to a number of different code detection boards.

[0026] Some of the different code detection boards which have already been installed in the system include: An interface board, coupled to the pixel bus, which contains logic for bar code predetection, A concentric ring detector, also coupled to the pixel bus, which performs an algorithm for detecting concentric ring targets. And for example, if optical character recognition is to be performed, an optical character recognition device can also be coupled to the pixel bus. Further code detectors can also be inserted into this architecture in order to simultaneously monitor the pixel bus and detect additional types of code. All of the processing of the simultaneous code detectors is performed in parallel with the system functions due to the parallel architecture of the multiple code camera system. For example height sensing is performed by the system processor in parallel with the various code detection algorithms.

[0027] Within the concentric ring acquisition target detector the data from the optical scanning device is arranged to form two-dimensional arrays representative of two-dimensional scanned regions through which the acquisition target passes. The resulting two-dimensional arrays of scanned data are correlated with selected correlation templates, wherein each correlation template represents an image of the concentric ring acquisition target at a predetermined height above the belt. This method may be applied to images undergoing any type of transform in addition to magnification provided that the transformed images may be represented as template images for correlation and identification. For example, an image may be identified if it is transformed by warping, by rotating or by positioning at varying angles or rotations with respect to the scanning device.

[0028] The optical scanning device is clocked at a rate

representative of the speed of the target to provide a constant number of scans per target regardless of the distance of the target from the optical scanning device. Thus the correlation templates are elliptical rather than round when they represent magnified images because magnification occurs only along the axis perpendicular to the direction of travel. The correct correlation templates are determined according to amount of magnification or warping, or the angle. The determined template is then placed into the two-dimensional correlators.

[0029] Within the ring detector differing stages are clocked at differing rates. However, it is necessary to provide constant throughput through the detector. This is achieved by interleaving the data and simultaneously performing independent processing on a current frame and a previous frame at stages of the detector.

[0030] The camera system does not require optical calibration adjustments. This is achieved by using extremely close tolerances in machining the housing for all holes used for mounting mirrors and other optical elements. Thus these elements can be secured at exactly the correct location when the camera system is assembled. Additionally, extremely close tolerance ribbing is provided so that when the reflector of the camera system is resiliently secured against the ribbing it maintains its correct elliptical shape. The illumination source of the multiple code camera system and the conveyor belt are disposed upon respective foci of an ellipse wherein the resiliently secured reflector above the illumination source is adapted to follow the shape of the ellipse.

[0031] In a camera system the scanning rate of the optical scanning device may be controlled by the belt speed. The belt speed is applied to the scanning device via the encoder output. Because the scan rate is controlled according to the belt speed, at lower belt speeds the amount of integration time per scan increases. Thus the illumination requirements of the optical scanning device decreases at lower belt speeds and increases at higher belt speeds. Compensation for the amount of illumination provided by the illumination source as well as compensation for the integration time is performed by adjusting the amplitude of the entire video signal based on the amplitude of a white reference.

[0032] Two methods for performing the white reference correction are provided. One method for performing the white reference correction is applying the encoder output to a frequency-to-voltage convertor and controlling the amplitude of the video signal from the optical scanning device according to the DC level output of this convertor.

[0033] Another method for performing the white reference integration uses light transmitted by way of fiber optic cables. In this method the fiber optic cables are arranged from each of the bulbs of the illumination source to selected pixels of the optical scanning device. These selected pixels are dedicated to the white reference integration and therefore are not available to rep-

resent information encoded upon an optical target.

[0034] Preferably separate optical fibers are run from each bulb of the illumination source to prevent bulbs from dominating each other due to their relative proximity to the sensor. The output signal of the scanning device corresponding to these dedicated pixels is then used to control the white reference integration. The encoder may also be used to control the illumination level of the illumination source. Thus the illumination source may be dimmed when the belt is travelling more slowly.

[0035] The dark reference is based upon the output of a blind cell within the optical scanning device which is sampled during each scan cycle. The problem solved by the dark reference integration is that in the output of the optical scanning device a small information value may ride upon a large DC offset. This offset can vary depending upon temperature and aging of the camera system. An iterative integration may be performed for each scan of the optical scanning device based upon the output of the dark cell to correct for the offset. The camera system thus performs continuously repeated integrations to maintain an offset correction on a scan-by-scan basis.

[0036] A multiple code camera system may be provided with a real time focusing system. In the real time focusing system an object height sensor constantly determines the distance from the camera to a surface below it. The camera optics of the multiple code camera are constantly focused according to this measured distance. In this real time focusing system, or continuous focus system, a delay between the measurement of a distance and the control of the camera optics according to the measured distance is adjusted according to the speed of the conveyor belt as determined from an encoder output.

[0037] The multiple code camera system may be provided with a forced air convection cooling circuit for cooling, for example, the electronics of the system. In this cooling circuit air is forced over the electronic circuits of the camera system, through a bleed channel, over the system power supply, through a heat exchange compartment, and back to the electronic circuits. In the heat exchange compartment, thermal exchange with the exterior of the camera system is permitted through the skin of the compartment. Additionally, the bleed-through channel between the electronics and the system power supply is adapted to permit dissipation of some of the system heat from the air circulating from the electronic circuits to the power system supply.

[0038] The camera of the multiple code camera system, the electronic circuits, and the system power supply are disposed in separately sealed compartments. The sealed electronic circuit compartment and the sealed system power supply compartment are in fluid communication with each other by way of the bleed-through channel. The overall air circuit is also sealed. Because the overall circuit is sealed, the circulated air is substantially dust free.

[0039] There are advantages to disposing a camera system such as a multiple code camera system horizontally rather than vertically. One important advantage is the ability to stack conveyor belts above each other more closely when the camera systems are disposed horizontally. Additionally, horizontally disposed systems are less subject to vibration. In the past these systems were always vertical and natural convection currents could be relied upon for cooling them. Thus it is because of the forced convection that the present system may be disposed horizontally.

[0040] Fig. 1 shows a side view of the multiple code camera system.

[0041] Fig. 2 shows a plan view of the multiple code camera system of Fig. 1.

[0042] Fig. 3 shows a side view of an alternate arrangement of the multiple code camera system of Fig. 1 wherein the alternate arrangement is disposed vertically and cooled by natural convection currents.

[0043] Fig. 4 shows a block diagram representation of the data processing architecture of the multiple code camera system of Fig. 1 for scanning moving targets simultaneously for a plurality of differing acquisition targets and a plurality of differing codes and acquiring and decoding the targets.

[0044] Fig. 5 shows a more detailed block diagram representation of a portion of the concentric ring acquisition target detector of the parallel architecture of Fig. 4.

[0045] Fig. 6 shows a more detailed block diagram representation of a portion of the concentric ring acquisition target detector of the parallel architecture of Fig. 4.

[0046] Fig. 7 shows a more detailed representation of the analog-to-digital converter of the parallel architecture of Fig. 4 for receiving and adjustably processing the output of the optical scanning device according to the speed of the conveyor belt.

[0047] Fig. 8 shows a partial view of the multiple code camera system of Fig. 1 including fiber optic bundles for transmitting light from the illumination source to the optical scanning device for performing a white reference integration.

[0048] Fig. 9 shows a block diagram representation of a system for controlling the illumination of the camera system of Fig. 1.

[0049] Fig. 10 shows a system for continuously focusing the camera of the multiple code camera system of Fig. 1.

[0050] Referring now to Fig. 1, there is shown a side view of horizontally disposed multiple code camera system 10. Within multiple code camera system 10 optically readable information-encoded label 44 is disposed upon moving package 42 which is transported by conveyor belt 20. As information-encoded label 44 is transported past camera axis 33, it is scanned by camera 50 of multiple code camera system 10 to provide electrical signals representative of light reflected off label 44. It will be understood that the light reflected off optically readable label 44 represents the information which is encoded in

label 44.

[0051] Illumination of optically readable information-encoded label 44 within multiple code camera system 10 is provided by adjustable illumination system 12. Adjustable illumination system 12 includes a plurality of illumination sources 15 or bulbs 15 each disposed within reflector box 13 and controlled by an individual power supply 16. Each individual power supply 16 may be separately controlled in a conventional manner in order to control the light energy provided by its corresponding illumination source 15.

[0052] Adjustable illumination system 12 of camera system 10 is also provided with elliptical reflector 14 within reflector box 13. Elliptical reflector 14 is conformed to the shape of a portion of illumination ellipse 18 by ribs 11 and thereby defines illumination ellipse 18. Elliptical reflector 14 is adapted to reflect light energy emitted from illumination sources 15 onto optically readable label 44 disposed above conveyor belt 20. Illumination sources 15 and conveyor belt 20 are disposed upon focuses 22, 24 of illumination ellipse 18, respectively.

[0053] Light emitted by illumination sources 15 and reflected from moving package 42, information-encoded label 44, and conveyor belt 20 is received by mirror box 31 by way of optical aperture 27. Light received by way of optical aperture 27 is folded by three mirrors 26 to provide folded optical path 30 within mirror box 31. The position of brackets 28, for example on mirror box walls 25, 29, are determined to very close tolerances. Thus the positions of mirrors 26 may be precisely determined thereby eliminating the need for calibration by the fixed optics of camera system 10. The increased total optical path length provided by folded optical path 30 makes multiple code camera system 10 less sensitive to the height of moving packages 42 above conveyor belt 20 as is well understood by those skilled in the art.

[0054] Horizontally disposed multiple code camera system 10 is provided with sealed forced air convection cooling system 37 for cooling electronics (not shown) and a system power supply (not shown) of camera system 10. Sealed forced air convection cooling system 37 includes impeller 34 for drawing hot air into heat exchange compartment 36 by way of heat exchange inlet 39 and forcing cooled air from heat exchanger compartment 36 by way of heat exchange outlet 38. Air is cooled within heat exchange compartment 35 by thermal exchange with the environment external to heat exchange compartment 36 through the skin of compartment 36. The cooled air expelled from compartment 36 by way of heat exchange outlet 38 is used within multiple code camera system 10 to cool both the system electronics and the system power supply.

[0055] Referring now to Fig. 2, there is shown a plan view of multiple code camera system 10. Multiple code camera system 10 is provided with three separately sealed compartments 40a,b,c. Separately sealed compartment 40a houses the system electronics of camera

system 10 and separately sealed compartment 40c houses the system power supply of camera system 10. Thus, the components within sealed compartments 40a, c are the components which must be cooled by forced air convection cooling system 37. Separately sealed compartment 40b houses camera 50, which does not require cooling within multiple code camera system 10. The positioning of the system electronics of compartment 40a and camera 50 of compartment 40b substantially close to each other within the same housing of camera system 10 permits very short cables between camera 50 and the electronics of compartment 40a. This results in better noise immunity within camera system 10.

[0056] In forced air convection cooling system 37 cooled air expelled from heat exchange outlet 38 is directed to separately sealed compartment 40a by way of an opening through the floor of compartment 40a. Cooled air from outlet 38 is then forced across circuit boards (not shown) within separately sealed compartment 40a in order to cool the electronic circuitry of camera system 10. After passing over the circuit boards of sealed compartment 40a air exits sealed compartment 40a by way of inlet 46 of bleed-through channel 42. Bleed through channel 42 extends from electronics compartment 40a to system power supply compartment 40c and serves as a conduit therebetween.

[0057] Bleed-through channel 42 of convection cooling system 37 is adapted to partially cool air which has been warmed by contact with the electronics of separately sealed compartment 40a as the air is conducted to compartment 40c. This partial cooling is achieved by permitting dissipation of thermal energy through the skin of bleed-through channel 42 to the environment external to multiple code camera system 10.

[0058] Partially cooled air from bleed-through channel 42 is then applied by way of channel outlet 48 to separately sealed compartment 40c which contains the system power supply (not shown) of multiple code camera system 10. This partially cooled air is effective to cool the power supply as it flows over the power supply toward heat exchange inlet 36. The warmed air from separately sealed compartment 40c is then cooled within heat exchange compartment 36 of convection cooling system 37. This forced convection circuit is then repeated when the cooled air is directed back to sealed compartment 40a by impeller 34.

[0059] As previously described, illumination sources 15 and conveyor belt 20 are disposed upon focuses 22, 24 of illumination ellipse 18, respectively. Light emitted from illumination sources 15 in an upward direction reflects off elliptical reflector 14 and is directed by elliptical reflector 14 in a substantially downward direction. It will be understood by those skilled in the art that light reflected in this manner by elliptical reflector 14 is focused substantially in the direction of focus 24. It will also be understood by those skilled in the art that light emitted from focus 22 at any angle would be reflected to focus

24 if elliptical reflector 14 is extended over the entire circumference of illumination ellipse 18. Thus, the shape of elliptical reflector 14 optimizes the amount of light energy emitted from illumination sources 15 which arrives at focus 24.

[0060] In order to define illumination ellipse 18 reflector 14 is resiliently disposed against ribs 11 within reflector box 13. It will be understood that if ribs 11 are produced with very close tolerances to define ellipse 18 that calibration of reflector 14 is not needed. Reflector 14 is merely bent, inserted against ribs 11, and caused to resiliently conform to the shape of ribs 11 when released.

[0061] Referring now to Fig. 3, there is shown vertically disposed multiple code camera system 100. Vertically disposed multiple code camera system 100 is an alternate arrangement of horizontally disposed multiple code camera system 10. Alternate arrangement camera system 100 is adapted to be disposed in a vertical position rather than in a horizontal position while scanning conveyor belt 20 for information-encoded label 44 disposed upon moving package 42. Vertically disposed camera system 100 is cooled by natural convection currents rather than the forced convection currents provided by forced air cooling system 37 for cooling the components of horizontally disposed camera system 10. Cooling system 37 of camera system 10 is effective to permit camera system 10 to function properly when disposed horizontally because it moves the air within camera system 10 to provide the cooling which is provided within vertically disposed multiple code camera system 100 by natural convection currents.

[0062] Thus, it will be understood by those skilled in the art that it is the forced air of convection cooling system 37 which permits multiple code camera system 10 to be disposed horizontally. Horizontally disposed camera system 10 is therefore adapted to be used more advantageously in applications where conveyor belts 20 are stacked above each other and camera system 10 must be positioned between conveyor belts 20. Additionally, in applications in which other items are disposed proximately above or below conveyor belt 20 preventing enough vertical space for vertically disposed camera system 100 it is advantageous to use horizontal camera system 10.

[0063] Furthermore horizontal positioning of multiple code camera system 10 permits camera system 10 to be used in environments which are subject to more vibration because vertically disposed systems such as camera system 100 are more sensitive to the vibration. However, it will be understood that when conditions requiring horizontal placement of a camera system are not present, the natural convection cooling of horizontally disposed camera system 100 is sufficient to dissipate the thermal energy of camera system 100 thereby eliminating the need for forced air convection cooling system 37.

[0064] Referring now to Fig. 4, there is shown parallel video processor architecture 150 of multiple code cam-

era systems 10, 100. Parallel video processor architecture 150 includes system processor 160, bar code interface processor 174, concentric ring detector processor 180, image processor 190, and digital signal processor 194, all coupled to the same processor system bus 170. It will be understood by those skilled in the art that coupling this plurality of processors 160, 174, 180, 190 and 194 to system bus 170 permits simultaneous processing of the system functions of camera systems 10, 100 as well as the video processing and target detection functions within parallel architecture 150. The system functions of multiple code camera systems 10, 100 include such functions as the processing of the height information of moving packages 42 upon conveyor belt 20.

[0065] Additionally, parallel video processor architecture 150 of camera systems 10, 100 is provided with pixel bus 172 which transmits image data. Pixel bus 172 applies the output data of optical scanning device 154, received by way of analog-to-digital convertor 166, to both bar code interface 174 and concentric ring detector 180. Because of the use of bus 172, both bar code interface 174 and concentric ring detector 180 may simultaneously operate upon the pixel data provided by optical scanning device 154 as optical scanning device 154 scans moving packages 42. Thus targets with both rectangular configurations and circular configurations may be searched for simultaneously.

[0066] The use of bar code interface 174 and concentric ring detector 180, coupled in this manner to pixel data bus 172, permits parallel architecture 150 of multiple code camera systems 10, 100 to simultaneously search for both bar codes and concentric rings. Additionally, optical character recognition system 182, or any further conventional code or target detection system, may be simultaneously coupled to pixel data bus 172 to permit simultaneous searching for additional types of information-encoded symbols or target configurations. It will be understood that if optical character recognition system 182 is applied to parallel architecture 150, system 182 may operate independently of image processor 190 and digital signal processor 194.

[0067] When bar code interface 174 or concentric ring target detector 180 detects, respectively, a bar code or concentric rings as a result of the simultaneous searching of the pixel data within parallel architecture 150, it provides a respective detect signal. It will be understood that a detect signal provided by bar code interface 174 indicates a pre-recognition of a bar code disposed upon information-encoded label 44. It will also be understood that a detect provided by concentric ring detector 180 indicates the preliminary detection of concentric rings disposed on information-encoded label 44.

[0068] In response to a detect signal from either interface 174 or detector 180, video image processor 190 and input/output digital signal processor 194 proceed with further processing of the detected symbol. This further processing occurs simultaneously with the processing of normal system functions by system processor

160. Thus it will be understood that digital signal processor 194 is not adapted to function as a co-processor for system processor 160.

[0069] In a similar manner, optical character recognition system 182 may monitor the pixel data of pixel data bus 172 simultaneously with the processing of bar code interface 174 and concentric ring detector 180. Thus optical character recognition system 182 may search for optical characters in parallel with the search for bar codes and concentric ring acquisition targets which may be disposed upon information-encoded labels 44. A separate detect signal may be provided by system 182 when an optical character is scanned by optical scanning device 154.

[0070] With respect to the system functions of parallel video processor architecture 150 it will be understood by those skilled in the art that system processor 160 is effective to coordinate and control all processing activities within parallel architecture 150. System processor 160 is also effective to control the interfacing with other peripherals (not shown) which may be coupled to camera systems 10, 100. The system functions performed by system processor 160 may include, but are not limited to, coordination of the focusing of camera 50, belt encoder 152, the height sensing operations associated with packages 42, as well as the coordination of analog-to-digital convertor 166, concentric ring detector 180, input/output digital signal processor 194 and image processor 190.

[0071] It will be understood that system processor 160 of parallel architecture 150 is also responsible for the data processing associated with the movement of packages 42. This package data processing by system processor 160 includes coordinating the leading and trailing edges of moving packages 42 with detected labels 44. It also includes controlling the movement of diverters (not shown) of a conveyor system wherein multiple code camera system 10 is applied. Additionally, system processor 160 may track system performance, log data and provide site configuration of the reader front end electronics. For example, heights of moving packages 42 may be recorded within the system functions performed by system processor 160 for the purpose of assigning labels 44 to moving objects 42 and determining points for diverter operation.

[0072] When signal processor 160 identifies moving packages 42 or other objects 42 on conveyor belt 20 using, for example, height sensing data, the objects 42 are recorded in an object cue within local memory 162 of system processor 160. Simultaneously, images of information-encoded labels 44 disposed upon packages 42 are stored in a label cue in local memory 191 of image processor 190. Digital signal processor 194 then provides an interrupt signal corresponding to each new optically readable label 44 scanned by optical scanning device 154 and its position on conveyor belt 20. When this interrupt is received by system processor 160 of parallel architecture 150, system processor 160 relates each la-

bel 44 to its package 42 based upon its position on conveyor belt 20. When image processor 190 completes processing and system processor 160 does final error correction, the decoding of the resulting label message is entered in the package cue.

[0073] Simultaneous with the performance of these system functions by system processor 160 images processor 190 performs the functions required for processing the images scanned by optical scanning device 154. Image processor 190 may perform such functions as fast Fourier transforms and inverse fast Fourier transforms for the detection of concentric ring acquisition targets. Image processor 190 may also serve as a processor for converting a label image into a stream of symbol element color states. Other functions of image processor 190 include edge enhancement, removal of concentric rings from label images and the determination of the orientation of labels 44. The control of data to and from image processor 190 is performed by system processor 160 as previously described.

[0074] Concentric ring detector 180 of parallel video processor architecture 50 converts and buffers the video data of pixel data bus 172 and the concentric ring detect signals. These signals are transmitted to interface 174 via bus 172. The interface 174 computes the coordinates of concentric rings and transmits to I/O digital signal processor 194 via bus 196. Digital signal processor 194 then locates images of actual information-encoded labels 44 amidst the video scan data at possible concentric ring locations after pre-recognition of the rings.

[0075] Parallel input/output block 164 of parallel video processor architecture 150 includes a large number of parallel input/output bits (not shown) and programmable timers (not shown). Belt encoder 152 applies a signal representing the speed of conveyor belt 20 to block 164 by way of line 153 and clocks two timers within parallel input/output block 164. One of these two timers is used to track the absolute position of conveyor belt 20. The other timer of block 164 clocked by belt speed encoder 152 is used to generate an interrupt when a predetermined length of conveyor belt 20 has passed. The ability of parallel input/output block 164 to provide interrupts in accordance with the output of belt speed encoder 152 permits parallel architecture 150 to compensate for the speed of conveyor belt 20.

[0076] When the presence of a concentric ring acquisition target within the region scanned by camera systems 10, 100 is indicated an interrupt is provided. This interrupt causes a block copy of the corresponding image of information-encoded label 44 to image processor 190. The image is then converted within image processor 190 into simple element color states and the results are transmitted to system processor 160 by way of system bus 170. The label data received by system processor 160 is matched to a particular package 42 disposed upon conveyor belt 20 and the symbol elements representative of label 44 upon package 42 are converted

ed into label information. For example, this label information may be an address or a zip code for packages 42.

[0077] When the interrupt signals occur, scaled images of information-encoded labels 44 are copied within parallel video processor architecture 150 from digital signal processor 194 to image processor 190. Processing of images within image processor 190 begins when one full unprocessed label image is formed within image processor 190. When the image processing is complete, image processor 190 writes the results to a temporary storage cue and informs system processor 160 by means of an interrupt.

[0078] Processing by image processor 190 results in a map of label symbol elements wherein each element is assigned a bit value. Additionally, a pixel map of the image originally presented to image processor 190 may be provided. Image processor 190 may also provide, for example, windowed images, enhanced images, frequency domain images, bright point coordinates, selected orientation, clock image and representations of the coordinates of each symbol element center.

[0079] Image processor 190 and input/output digital signal processor 194 are coupled to each other, and to interface 174, by way of image bus 196. Image bus 196 is a high speed data path of the kind known to those skilled in the art of circuitry for the processing of video images, such as image processor 190. It is by way of image bus 196 that interface board 174 applies a black and white version, or raw image, to image processor 190 in a compressed format.

[0080] Additionally, low pass filtering is performed on interface board 174 for clumping white points together with each other and clumping black points together with each other. The clumped points are applied to image processor 190 for bar code detection by way of image bus 196. It will be understood that a detect of concentric rings by interface board 174 just provide a flag and does not produce the exact coordinates of the center of the concentric rings. Finding the exact coordinates of the center is performed by image processor 190 after the data is applied by interface 174 to image processor 190 by way of image bus 196.

[0081] Referring now to Figs. 5, 6, there is shown a more detailed representation of concentric ring target detector 180 of parallel video processor architecture 150 within multiple code camera systems 10, 100. Concentric ring target detector 180 receives input pixel data from optical scanning device 154 on input lines 200, 202 by way of analog-to-digital convertor 166 and pixel data bus 172. The pixel data received from scanning device 154 by way of convertor 166 and bus 172 are representative of images of conveyor belt 20 and moving objects 42 bearing information-encoded labels 44 which are advanced by conveyor belt 20.

[0082] The input pixel data is applied, alternately, to first-in first-out block 204 and first-in first-out block 206 by way of both odd pixel input line 200 and even pixel

input line 202. This alternate writing of pixels into first-in first-out blocks 202, 204 is performed under the control of write control line 218 of first-in first-out block 204 and write control line 222 of first-in first-out block 206. Write control lines 218, 222 are alternately active one-half of the time during operation of concentric ring detector 180.

[0083] Thus, both odd and even pixels are simultaneously applied to first-in first-out block 204 during one half of the time that detector 180 is in operation by way of detector input lines 200, 202. During the other half of the operation, both odd pixels and even pixels are simultaneously applied to first-in first-out block 206 by detector input lines 200, 202.

[0084] It will therefore be understood that during the write operations of concentric ring detector 180, the pixels received by each first-in first-out block 204, 206 include both odd pixels, by way of input line 200, and even pixels, by way of input line 202. In this manner detector input lines 200, 202 both constantly supply pixel data to one or the other of the two blocks 204, 206 within concentric ring detector 180. Input lines 200, 202 both apply pixels to block 204 when write control line 218 is active (during odd scan lines) and input lines 200, 202 both apply pixels to block 206 when write control line 222 is active (during even scan lines).

[0085] Thus block 204 contains both the odd pixels and the even pixels of a current scan line N and block 206 contains both the odd pixels and the even pixels of a previous scan line N-1. The pixels thus received by first-in first-out blocks 204, 206 are then applied to multi-tap first-in first-out block 228 by way of pixel switching system 225. Therefore, first-in first-out blocks 204, 206 may each receive one-half of the pixels from digital-to-analog board 166 and apply pixels their respective pixels to pixel switching system 225 at one-half the rate at which they were received by way of detector input lines 200, 202.

[0086] As described the rate at which first-in first-out block 204 applies data by way of current scan lines 208, 210 to pixel switching system 225 is one-half of the rate at which data is applied to first-in first-out block 204 by way of detector input lines 200, 202. Similarly, the rate at which first-in first-out block 206 applies data to pixel switching system 225 by way of previous scan lines 212, 214 is one half of the rate at which data is applied to first-in first-out block 206 by way of detector input lines 200, 202.

[0087] The transmission of data through each first-in first-out block 204, 206 may thus be understood by means of an analogy to filling a fluid container while the fluid container is simultaneously draining at one-half of the filling rate. If two such fluid containers are provided, and each is filled one-half of the time while both drain constantly, the total throughput may remain constant without the containers ever overflowing or emptying. The constant rate of the throughput of such a fluid system is twice the draining rate of a single one of the con-

tainers.

[0088] Both first-in first-out blocks 204, 206 apply data to pixel switching system 225 the entire time that concentric ring detector 180 is operating. This constant flow of data from blocks 204, 206 occurs under the control of read control line 220. It will be understood that, unlike separate write control lines 218, 222, single read control line 220 is applied to both blocks 204, 206 simultaneously. This is done in order to permit both blocks 204, 206 to constantly and simultaneously apply their data to pixel switching system 225 even though only one of them is receiving data at a time. It will also be understood that all four block output lines 208, 210, 212, 214 are constantly active when data is applied to ring detector system 180.

[0089] Because of the conventional design of optical scanning device 154, wherein odd pixels and even pixels are provided separately, first-in first-out block 204 is adapted to receive odd pixels and even pixels separately by way of detector input lines 200, 202. First-in first-out block 204 then outputs the received pixels separately as odd pixels and even pixels on lines 208, 210 respectively. Thus, switch 225a of pixel switching system 225 toggles and alternately receives an odd pixel from block output line 208 and an even pixel from block output line 210. In this manner, switch 225a of switching system 225 puts the pixels of lines 208, 210 back into serial order for application to multi-tap first-in first-out block 228 by way of current scan line 224.

[0090] In a similar manner, first-in first-out block 206 provides odd pixels on output line 212 and even pixels on output line 214. The odd and even pixels of lines 212, 214 are alternately received by pixel switching system 225 and put into serial order by the toggling of switch 225b of pixel switching system 225. The scan data put into serial order by switch 225 is applied to multi-tap first-in first-out block 228 by way of current scan line 224 and previous scan line 226. Pixels applied to first-in first-out block 228 by way of current scan line 224 and previous scan line 226 are then shifted through block 228. Output tap system 230 of block 228 is provided to permit a read of each pixel written to block 228 by way of scan lines 224, 226 on each cycle as the pixels are shifted through block 228.

[0091] Output taps 230₀-230₃₁ of output tap system 230 are applied to template correlator 240 and output taps 230₁-230₃₂ are applied to template correlator 242. Taps 230₀-230₃₁ apply a current image frame of a possible concentric ring target to template correlation 240. In a similar manner taps 230₁-230₃₂ of output tap system 230 contain the image frame previous to the current image frame. Thus, two different image frames are compared simultaneously, one within template correlator 240 and other within template correlator 242 of concentric ring detector 180.

[0092] As previously described, moving package 42, bearing information-encoded label 44, is transported by conveyor belt 20 within camera systems 10, 100. Any

height sensing device 260 (for example a conventional light curtain) may be used to determine the height of moving package 42 and, therefore, the distance between information-encoded label 44 and optical scanning device 154. The height information from height sensing device 260 is applied to height processor 258. Height processor 258 uses this height information to select one of a predetermined number of templates $T_1 \dots T_N$ stored in template block 256 of local memory 191 within image processor 190.

[0093] Templates $T_1 \dots T_N$ stored within template block 256 each represent an image of a concentric ring acquisition target disposed on information-encoded label 44 at one of several predetermined heights as scanned by optical scanning device 154. For example, template T_1 may correspond to a scanned image of the concentric ring target at the level of conveyor belt 20 while template T_N may correspond to an image of concentric rings at the maximum permitted height of moving package 42.

[0094] Thus, in accordance with the height information from height sensor 260, a selected template T_i corresponding to the height of moving package 42 sensed by height sensor 260 is retrieved by template selector 254. The selected template T_i is then applied to both template correlators 240, 242 by way of common template correlation line 252. In this manner, both a current scan of scanning device 154 and a previous scan are correlated with the selected template T_i simultaneously within concentric ring detector 180. If either template correlator 240 or template correlator 242 achieves above a predetermined correlation threshold, a detection signal as applied to gate 248 by way of either correlator output line 244 or correlator output line 246. When a correlation signal is applied to gate 248 by way of either line 244 or line 246, detection signal line 250 goes active at a point where the coordinates of the center of the concentric rings disposed on information-encoded label 44 can be determined.

[0095] Referring now to Fig. 7, there is shown a more detailed representation of analog-to-digital converter 166 of parallel video processor architecture 150. The pixel data video signal from optical scanning device 154 is applied to analog-to-digital converter 166 by video scanner output line 168. The video information received by analog-to-digital converter 166 is applied to ideal diode 300 by way of summation circuit 280. The output of ideal diode 300 is applied to analog-to-digital block 304 which converts the analog signal output of ideal diode 300 to a digital signal. This digital signal output is applied to pixel decoding bus 172 by way of converter output line 310.

[0096] In addition to the analog-to-digital conversion performed by analog-to-digital block 304 within converter 166, a dark level or DC offset correction and a white level or gain correction are performed within converter 166 upon the pixel data received from optical scanning device 154. These two corrections eliminate the need

for several calibrations within multiple code camera systems 10, 100. The calibrations eliminated are both those associated with bringing camera systems 10, 100 on-line and those associated with wear and aging of components within camera systems 10, 100.

[0097] The dark level or DC offset correction integration within converter 166 is performed by dark reference integration loop 340. In dark reference integration loop 340 the output of analog-to-digital converter block 304 is applied back to the input of analog-to-digital converter block 304 by way of integrator 284 and summation node 280. The white level or gain correction within converter 166 is performed by white reference integration feedback loop 360. In light reference integration loop 360 the output of analog-to-digital converter block 304 is applied back to the input of analog-to-digital converter block 304 by way of summation node 314 and integrator 312.

[0098] Dark reference integration loop 340 performs a correction for the DC offset of the video signal provided by optical scanning device 154 within camera 50. It will be understood by those skilled in the art that the information signals provided to analog-to-digital converter 166 for processing may be on the order of twenty millivolts, while the DC offset may be on the order of nine volts. Additionally, it will be understood that the twenty millivolts of useful information may be only a portion of the signal riding on top of the DC offset. The remaining portions riding on the offset may correspond to artifacts caused by optical scanning device 154. Furthermore, these artifacts may be an order of magnitude greater than the information signal. This information signal within the output of scanning device 154 portion must be extracted for each one of the video pixels.

[0099] The white integration is provided in analog-to-digital converter 160 because the high speed of moving objects 44 does not permit very much time for the light from illumination system 12 of camera system 10 to accumulate charge within optical scanning device 154 of camera 50. Thus the signal output on scanner output line 168 of camera 50 has a small difference between a pixel corresponding to the brightest spot scanned by camera 50 and a pixel corresponding to the darkest spot scanned by camera 50. This small difference is amplitude requires special processing within converter 166. Additionally, the amplitude of signals from optical scanning device 154 corresponding to a constant amount of light changes with age, component sensitivity and other factors.

[0100] In order to permit compensation for the DC offset of the output of optical scanning device 154 there is a dark reference pixel which corresponds to a dedicated sensor element within device 154. The dedicated sensor element for the dark pixel is not exposed to light within scanning device 154. This dedicated sensor element accumulates a charge based upon factors other than light exposure. For example, the charge accumulated by this sensor element depends upon thermal effects within device 154. A value corresponding to the change

accumulated by this dedicated sensor element is provided at the output of optical scanning device 154.

[0101] Thus, the output of the dedicated sensor element corresponding to the dark pixel may be used to set the black level within camera systems 10, 100 by clamping the signal of video output line 168 to the output of that element. This may be used to null the DC offset. When the clamped signal is applied to ideal diode 300, ideal diode 300 eliminates much of the unwanted artifacts from the video signal. The amplitude of the remaining signal corresponds to the brightness of the pixels of scanning device 154.

[0102] When the dark pixel is applied to multiplier 302, it is known when the black pixel will appear at the output of multiplier 302. When the black pixel appears at the output of multiplier 302 and it is converted to a digital signal by convertor 304, digital-to-analog convertor block 290 is triggered. Thus, the output of digital-to-analog convertor block 290 is an analog representation of the output of the dark pixels of optical scanning device 154. This output is applied to dark level integrator 284 by way of lines 286, 288. Dark level integrator 284 then provides a DC offset adjust signal in accordance with the output of the dark pixel. This DC offset adjust signal is applied by integration output line 282 to summation node 280 in order to clamp the signal from optical scanning device 154 on scanner output line 168 such that the DC offset is zero.

[0103] Within analog-to-digital converter 166 the operations of dark reference integration feedback loop 340 are repeated for each scan of optical scanning device 154. Thus, during each scan cycle, the corresponding dark pixel is used to iteratively readjust the DC offset correction by means of summation node 280 or offset correction node 280 in accordance with the output of dark level integrator 284.

[0104] In addition to the dark reference pixel provided by optical scanning device 154 during each scan, a white reference pixel is provided during each scan of optical scanning device 154 in order to compensate the whiteness of the image or amplitude of the signal. It will be understood by those skilled in the art that this is necessary because as the speed of conveyor belt 20 increases and the scan rate of optical scanning device 154 increases there is less time for charge to accumulate within optical scanning device 154. This results in a correspondingly lower information amplitude within the video output signal of line 168. Additionally, the user of camera systems 10, 100 may adjust a calibration trimpot (not shown) in order to set a voltage level which is injected into optical scanning device 154 as a white reference pixel. White feedback loop 360 of analog-to-digital converter 166 iteratively corrects for the changing speed and the setting of the trimpot.

[0105] When the white reference pixel is applied to analog-to-digital block 304, digital-to-analog block 316 is triggered. This causes an analog representation of the level of the white reference pixel to be applied to sum-

mation node 314 by way of lines 326, 328 of block 316. The output of summation node 314 may thus be used for the purpose of providing white reference feedback to the input of analog-to-digital block 304 by way of multiplier 302.

[0106] In addition to the analog representation of the amplitude of the white reference pixel of optical scanning device 154, summation node 314 is also acted upon by frequency-to-voltage convertor 324 by way of lines 318, 320. It will be understood by those skilled in the art that variations in the speed of conveyor belt 20 result in signals of varying frequency at the output of belt encoder 152. In order to compensate for the resulting changed output amplitude from optical scanning device 154 the variable frequency output of belt encoder 152 is applied to frequency-to-voltage convertor 324 by way of encoder output line 153.

[0107] Thus, a signal representative of both the white reference pixel and the speed of conveyor belt 20 is applied by summation node 314 to white reference integrator 312. White reference integration feedback loop 360 containing white reference integrator 312 thus may provide an integrated feedback control signal wherein control of integrator 312 is provided according to the current amplitude of the white reference and the speed of conveyor belt 20. This control signal is applied to analog-to-digital block 304 in combination with the input signal and dark reference feedback signal.

[0108] In addition to the analog signals provided by digital-to-analog blocks 290, 316, a third analog output signal corresponding to the output of analog-to-digital block 304 is provided within converter 166. This third analog signal appears at the output of digital-to-analog block 330. The analog output signal of digital-to-analog block 330 is provided within analog-to-digital converter 166 for the purpose of assisting in the detection of concentric ring acquisition targets which may be present on information encoded labels 44.

[0109] Thus, the output of digital-to-analog block 330, possibly including electrical signals representing a scanned concentric ring target on label 44, is applied to bandpass filter 332. Bandpass filter 332 of convertor 166 is adapted to pass the frequencies corresponding to a scan of concentric rings by optical scanning device 154. It will be understood that concentric rings at varying distances from optical scanning device 154 are imaged by device 154 with varying amounts of magnification. Thus the corner frequencies of bandpass filter 332 are selected to be those frequencies corresponding to a scan of a target label 44 at the level of conveyor belt 20 and a scan of a target at the maximum height of object 42. Other filtering techniques will be known to those skilled in the art.

[0110] The output signal of bandpass filter 332 is applied to threshold comparator 334 which is a one bit analog-to-digital conversion, converting all positive signals to one value and all negative signals to another value. The output of threshold comparator 334 in the preferred

arrangement of converter 166 is a substantially binary value which is applied to concentric target detector 180 by way of bus 172. Concentric target detector 180 uses this signal to assist in the detection of a concentric ring acquisition target passing through the field scanned by optical scanning device 154. This signal is usually effective to locate a concentric ring acquisition target to within ± 2 pixels.

[0111] Referring now to Fig. 8, there is shown white reference feedback system 400 which is used in an alternate arrangement of white reference integration feedback loop 360. White reference feedback system 400 may be used within multiple code camera systems 10, 100 to adjust the white reference seen by integrator 312 within analog-to-digital conversion 166 in place of belt speed encoder 152. Additionally however, white reference feedback system 400 may be used to control the amount of illumination provided by illumination sources 15 of illumination system 12 within camera systems 10, 100.

[0112] In white reference feedback system 400, a plurality of fiber optic bundles 402 are applied to illumination system 12. Light receiving ends of fiber optic bundles 402 are disposed in the vicinity of each illumination source 15. Light received from each source 15 by respective fiber optic bundles 402 is transmitted by bundles 402 to optical scanning device 154. In order to apply the transmitted light to optical scanning device 154 the light emitting ends of fiber optic bundles 402 are disposed in mirror box 31 substantially close to optical scanning device 154. Thus the transmitted light from each illumination source 15 is applied substantially directly to predetermined pixels of optical scanning device 154 within camera 50.

[0113] The predetermined target pixels of optical scanning device 152 receiving the transmitted light from the light emitting ends of fiber optic bundles 402 are dedicated as white references for white reference system 400 used within camera systems 10, 100. Therefore these dedicated pixels are not available to represent information encoded upon label 44 when scanning device 154 reads label 44. The predetermined target pixels may, for example, be the twenty pixels at an end of a scanner having 4,096 pixels within optical scanning device 154. Because individual optical bundles 402 are provided for each illumination source 15 or bulb 15 of illumination system 12, each bulb 15 is prevented from dominating other bulbs 15 due to relative proximity to a common light intensity sensor.

[0114] The output signal of pixel data from optical scanning device 154 corresponding to these dedicated pixels may then be used within analog-to-digital converter 166 of parallel architecture 150 to perform the white reference correction of feedback loop 360 as previously described. In this arrangement the light transmitted directly from illumination sources 15 is used to control the integration performed by white integrator 312 in substantially the same manner as that described with re-

spect to the output signal belt encoder 152 on encoder output line 155. It will therefore be understood by those skilled in the art that white integrator 312 may be controlled either in accordance with the light output of bulbs 15 transmitted by fiber optic bundles 402 or in accordance with the speed of conveyor belt 20 as indicated by the output of belt encoder 152.

[0115] Referring now to Fig. 9, there is shown adaptive illumination control system 450. In adaptive illumination control system 450, light sensor 452 senses the amount of light energy emitted by illumination source 15. Light sensor 452 applies a feedback system to lamp power supply 16 according to the sensed light energy. Lamp power supply 16 varies the amount of light energy emitted by illumination source 15 by varying the amount of power applied to illumination source 15.

[0116] The amount of power applied by lamp power supply 15 within control system 450 is also controlled according to the speed of conveyor belt 20 as indicated by the frequency of the output of belt speed encoder 15. The output of belt speed encoder 152 is applied to frequency to voltage converter 324 as previously described in order to provide a control voltage for lamp power supply 16.

[0117] Thus in illumination control system 450 control of lamp power supply 16 by belt speed encoder 152 is conditioned by the feedback to lamp power supply 16 from light sensor 452. The feedback from light sensor 452 may be obtained in accordance with reference feedback system 400 wherein fiber optic bundles 402 transmit light energy from illumination sources 15 to optical scanning device 154 and the output of optical scanning device 154 is used to control sources 15 by system processor.

[0118] Referring now to Fig. 10, there is shown continuous focus system 500. Continuous focus system 500 may be used to continuously focus camera 50 of multiple code camera systems 10, 100 in real time. Within focusing system 500 the scanning distance between camera 50 and a surface below camera 50 is constantly measured by distance sensor system 506. Distance sensor system 506 is preferably adapted to measure the distance from camera 50 downward to conveyor belt 20 or to the top surface of moving object 42 disposed upon conveyor belt 20.

[0119] It will be understood that distance sensor system 506 of continuous focus system 500 may be any conventional sensor system such as an ultrasonic system or an infrared system. Since each ultrasonic distance sensor system 506 may cover, for example, an area of conveyor belt 20 having a diameter of approximately seven inches, several ultrasonic sensors 506 aligned across conveyor belt 20 are required within camera systems 10, 100. Those skilled in the art will understand that ultrasonic sensors are more sensitive to the angle of information-encoded labels 44 in this type of application.

[0120] In continuous focus system 500, distance sen-

sensor system 506 emits pulses of, for example, soundwaves 504 in the direction of conveyor belt 20. Soundwaves 504 reflect from the surface of conveyor belt 20 or the top surface of moving object 42 and returning soundwaves 502 travel back to sensor system 506. The pulses of soundwaves 504 of sensor system 506 are initiated by mod 508 according to a trigger signal applied to mod 508 by way of trigger line 510. The trigger signal of trigger line 510 is controlled according to the output frequency of belt speed encoder 152 by way of encoder output line 153. Thus the timing of the pulses of soundwaves 504 is controlled according to the speed of conveyor belt 20.

[0121] It will be understood by those skilled in the art that the amount of time which elapses between the launching of a pulse of soundwaves 504 and the reception of corresponding return soundwaves 502 depends on the distance between sensor system 506 and a surface below it. Thus in addition to emitting soundwaves 504, mod 508 also detects the occurrence of return soundwaves 502 and provides an echo signal on line 512.

[0122] Counter/timer 520 of continuous focus system 500 starts counting when a trigger signal is applied to mod 508 by way of trigger line 510 in accordance with encoder 152 thereby initiating a pulse of soundwaves 504. Counter/timer 520 also receives the echo signal of line 512 from mod 508 when sensor system 506 receives return soundwaves 502. Counter/timer 520 is adapted to begin timing when trigger signal 510 is received and stop counting when echo signal 512 is received. Therefore the count within counter 520 is representative of the time required for a signal to travel from sensor system 506, bounce off a surface, and return to system sensor 506. Thus, the count within counter 520 is representative of the distance between sensor 506 and the surface. Therefore the count within counter 520 is representative of the distance between optical scanning device 154 and camera 50 and the surface.

[0123] This distance may then be used by a focusing system to control the focus of camera 50 according to the distance between camera 50 and the surface being scanned by camera 50. This focusing may be performed by any manner known to those skilled in the art. In the system 500, optical scanning device 154 may travel 0.30 inches under the control of amplifier 530 in order to focus on labels 44 ranging from the level of conveyor belt 20 to thirty-six inches above the level of belt 20.

[0124] It will be understood that the use of the count in counter 520 to focus the camera 50 must be delayed according with the distance between camera axis 522 and sensor axis 524 as well as the speed of conveyor belt 20. Therefore in order to delay the use of the count data in counter 520 to control the focus of camera 50 in accordance with the speed of conveyor belt 20, delay element 524 is provided. Delay element 524 may be a conventional first-in first-out block 524 controlled according to the output of belt encoder 152. The delayed

output of counter 520 at the output of delay element 524 is then applied to digital-to-analog block 528, filtered and amplified in block 530, and applied to voice coil 532. Voice coil 532 is coupled to optical scanning device 154 by means of rod 534 for displacing optical scanning device 154 according to the output of digital-to-analog converter 528.

[0125] Concentric ring acquisition targets such as those detected by concentric ring detector 180 of parallel architecture 150 are taught in U.S. Patent No. 4,874,936, entitled "Hexagonal Information Encoding Article, Process and System", and U.S. Patent Nos. 4,896,029 and 4,998,010, entitled "Polygon Information Encoding Article, Process and System", all three of which issued to Chandler.

[0126] It will be understood that various changes in the details, materials and arrangements of the parts which have been described and illustrated in order to explain the nature of this invention may be made by those skilled in the art without departing from the principle and scope of the invention as expressed in the following claims.

Claims

1. An optical target acquisition system (10, 100) for the detection of a plurality of optical targets located on labels (44), the targets having at least first and second differing target configurations and target data signals representative of said differing target configurations, comprising:

means (154) for capturing an image of a label;

first target processor means (174, 180, 182) for receiving said image including said target data signals and detecting said first target configuration in accordance with said target data signals to provide a first acquisition target detection signal;

second target processor means (174, 180, 182) separate from said first target processor means for receiving said image including said target data signals and detecting said second target configuration in accordance with said target data signals to provide a second acquisition target detection signal; and

third processor means (190) separate from said first and second processor means, for determining the orientation of the label in the captured image.

2. The optical target acquisition system of claim 1, further comprising detection means (190, 194) coupled to said first and second processor means (174,

- 180, 182) for receiving said first and second detection signals from said first and second target processor means (174, 180, 182) and acquiring said target in accordance with said first and second detection signals.
3. The optical target acquisition system of claim 2, wherein said first and second differing target configurations are provided with associated information encoded in accordance with first and second differing encoding methods, said detection means (190, 194) comprising:

differing first and second decoding means for decoding said information encoded in accordance with said first and second differing encoding methods respectively; and,

means for selecting one of said differing first and second decoding means in accordance with said received first and second detection signals.
 4. The optical target acquisition system of claim 2, further comprising target signal transmission means (172) coupled to said first and second target processor means (174, 180, 182) for receiving said target data signals and transmitting said target data signals to said first and second target processor means (174, 180, 182).
 5. The optical target acquisition system of claim 4, wherein said first and second target processor means (174, 180, 182) each receive and process identical target data signals from said target signal transmission means (172) simultaneously.
 6. The optical target acquisition system of claim 4, further comprising system bus means (170) independent of said target signal transmission means (172) for coupling said first and second target processor means (174, 180, 182) to said detection means (190, 194).
 7. The optical target acquisition system of claim 6, further comprising system processor means (160) separate from said first and second target processor means (174, 180, 182) and coupled to said system bus means (170) for receiving system data signals from said system bus means (170) and executing system functions in accordance with said received system data signals.
 8. The optical target acquisition system of claim 7, wherein said detecting of said first and second target configurations and said executing of said system functions occur simultaneously.
 9. The optical target acquisition system of claim 1, wherein at least one of said first and second differing target configurations comprises a rectangular target configuration.
 10. The optical target acquisition system of claim 1, wherein at least one of said first and second differing target configurations comprises a circular target configuration.
 11. The optical target acquisition system of claim 1, wherein said first and second differing target configurations comprise a rectangular target configuration and a circular target configuration.
 12. The optical target acquisition system of claim 11, wherein said rectangular target configuration is formed of a bar code.
 13. The optical target acquisition system of claim 12, wherein said circular target configuration is formed of a plurality of concentric rings.
 14. The optical target acquisition system of claim 1, wherein a plurality of differing target transforms are applied to said optical target to provide a plurality of transformed target images, further comprising:

a plurality of template images representative of said plurality of transformed target images; and,

means (254) for selecting a template image of said plurality of template images in accordance with a selected target transform.
 15. The optical target acquisition system of claim 14, further comprising:

means (240, 242, 248) for comparing said selected template image and said target data signals to provide a detection signal in accordance with said comparing; and,

means (190, 194) for acquiring said target in accordance with said detection signal.
 16. The optical target acquisition system of claim 14, wherein said differing target transforms comprise differing target magnifications.
 17. The optical target acquisition system of claim 16, further comprising a conveyor surface (20) for disposing an object (42) upon said conveyor surface (20) to process said object (42) according to optically encoded information disposed upon said object (42) wherein said means (254) for selecting said template image comprises means for selecting

in accordance with the distance between said object (42) and image means (154) for providing said target data signals.

18. The optical target acquisition system of claim 17, further comprising:

decoding means (190, 194) for decoding said optically encoded information disposed upon said object; and,

means for diverting said object in accordance with said decoding means.

19. An optical target acquisition system for the detection of optical targets located on labels (44), said system having system data signals independent of said image data signals for controlling system functions, and further comprising:

an optical scanning device (154) for capturing an image of a label;

first system processor means (160) including means for receiving said system data signals for executing said system functions by said first system processor means (160) in accordance with said system data signals;

second target processor means (174, 180, 182, 194) separate from said first system processor means for receiving said image and detecting said optical target to provide an acquisition target detection signal;

said second target processor means (174, 180, 182, 194) having means (170) for transmitting said detection signal to said first system processing means (160); and

third processor means (190) separate from said first and second processor means, for determining the orientation of the label in the captured image.

20. The optical target acquisition system of claim 19, wherein said means (170) for transmitting said detection signal comprises first system bus means (170) coupled to said first system processor means (160) for directly applying said detection signal to said first system processor means (160) from said second target processor means (174, 180, 182, 194).

21. The optical target acquisition system of claim 20, further comprising second image data bus means (172) coupled to said second target processor means (174, 180, 182, 194) for receiving said image

data signals from said optical scanning device (154) and applying said image data signals to said second target processor means.

22. The optical target acquisition system of claim 21, wherein said second image bus means (172) is independent of said first system bus means (170).

23. The optical target acquisition system of claim 19, wherein said executing of said system functions and said detecting of said optical target occur simultaneously within said first and second processor means (160, 174, 180, 182, 194) respectively.

24. The optical target acquisition system of claim 19, further comprising a plurality of said second target processor means (174, 180, 182, 194) for detecting a corresponding plurality of differing target configurations of said optical targets.

25. The optical target acquisition system of claim 24, further comprising second image data bus means (172) for transmitting said image data signals wherein each of said plurality of second target processing means (174, 180, 182, 194) is coupled to said second image data bus means (196) for receiving image data signals from said image data bus means and processing said image data signals simultaneously.

26. The optical target acquisition system of claim 24, wherein said differing target configurations comprise a rectangular target configuration and a circular target configuration.

27. The optical target acquisition system of claim 26, wherein said differing target configurations include a bar code configuration and a concentric ring configuration.

28. The optical target acquisition system of claim 19, wherein said second target processor means (174, 180, 182, 194) comprises fourth prerecognition processor means (174, 180, 182) for preliminary detection of said optical target and fifth digital signal processor means (194) for further determining said optical target, said fifth digital signal processor means being independent of said fourth prerecognition processor means (174, 180, 182).

29. The optical target acquisition system of claim 28, further comprising a plurality of said fourth prerecognition processor means (174, 180, 182).

30. The optical target acquisition system of claim 29, wherein said fifth processor means (194) decodes further optically encoded information associated with said optical target.

31. The optical target acquisition system of claim 19, wherein a plurality of differing target transforms are applied to a selected optical target to provide a plurality of transformed target images, including means (174, 180) for detecting a selected target having a selected target transform applied to said selected target, further comprising:

a plurality of template images representative of said plurality of transformed target images; and,

means (254) for selecting a template image of said plurality of template images in accordance with said selected target transform.

32. The optical target acquisition system of claim 31, further comprising:

means (240, 242, 248) for comparing a selected transformed target image and said selected template image and providing said detection signal in accordance with said comparing; and,

means (190, 194) for acquiring said selected target in accordance with said detection signal.

33. The optical target acquisition system of claim 31, further comprising a conveyor surface (20) for disposing an object (42) upon said conveyor surface (20) to scan said object (42) with image means (50, 154) and to process said object (42) according to optically encoded information disposed upon said object (42) wherein said means (254) for selecting a template image comprises means (254) for selecting a template image in accordance with the distance from said image means (50) to said object (42).

34. The optical target acquisition system of claim 33, further comprising:

means (190, 194) for decoding information disposed upon said object; and,

means for diverting said object in accordance with said decoded information.

35. An optical target acquisition method for detecting a plurality of optical targets located on labels (44), the targets having differing target configurations and associated encoded information, comprising the steps of:

(a) capturing an image of a label and providing image data including signals representative of first and second differing target configurations;

(b) receiving and transmitting said image data signals by image data signal transmission means (172);

(c) receiving said transmitted image data signals and detecting said first target configuration in accordance with said transmitted target data signals by first processor means (174, 180, 182) coupled to said image data signal transmission means to provide a first acquisition target detection signal;

(d) receiving said transmitted image data signals and detecting said second target configuration in accordance with said transmitted target data signals to provide a second acquisition target detection signal by second processor means (174, 180, 182) separate from said first processor means (174, 180, 182) and coupled to said image data signal transmission means (172); and

(e) determining the orientation of the label in the captured image by third processor means (190) separate from said first and second processor means.

36. The optical target acquisition method of claim 35, comprising the further steps of:

(f) receiving said first and second detection signals from said first and second processor means (174, 180, 182) by detection means (190, 194) coupled to said first and second processor means; and,

(g) detecting one of said first and second target configurations in accordance with said first and second detection signals.

37. The optical target acquisition method of claim 36, comprising the further steps of:

(h) selecting one of first and second decoding means in accordance with said received first and second detection signals; and,

(i) decoding said associated encoded information of said targets by first and second decoding means.

38. The optical target acquisition method of claim 36, further comprising the step of simultaneously processing the same transmitted target data signals in step (c) and step (d).

39. The optical target acquisition method of claim 36, further comprising system bus means (170) inde-

pendent of said target signal transmission means (172) for coupling said first and second processor means (174, 180, 182) to means (190, 194) for performing the detection of step (g).

40. The optical target acquisition method of claim 39, comprising the further steps of receiving system data signals from said system bus means (170) and executing system functions in accordance with said received system data signals by system processor means (160) separate from said first and second processor means (174, 180, 182) and coupled to said system bus means (170).
41. The optical target acquisition method of claim 40, wherein the steps of detecting said target and executing said system functions occur simultaneously.
42. The optical target acquisition method of claim 35, wherein said first and second target configurations comprise a rectangular target configuration and a circular target configuration.
43. The optical target acquisition method of claim 42, wherein said rectangular target configuration is formed of a bar code and said circular target configuration is formed of a plurality of concentric rings.
44. The optical target acquisition method of claim 35, wherein a plurality of differing target transforms are applied to said optical target to provide a plurality of transformed target images, comprising the further steps of:
 - (j) providing a plurality of template images representative of said plurality of transformed target images;
 - (k) selecting a template image of said plurality of template images in accordance with a selected target transform; and,
 - (l) comparing said selected template image and said target data signals to acquire said optical target in accordance with said comparing.
45. The optical target acquisition method of claim 44, wherein said differing target transforms comprise differing target magnifications.
46. The optical target acquisition method of claim 45, including the further step of disposing an object (42) upon a conveyor surface (20) to process said object according to optically encoded information disposed upon said object (42) imaged by optical image means (50) wherein the step of selecting said template image comprises the step selecting in accordance with the distance between said object and

said image means (50).

47. The optical target acquisition method of claim 46 comprising the further steps of:

(m) decoding said information disposed upon said object (42); and,

(n) diverting said object (42) in accordance with said decoded information.

48. A method for the acquisition of optical targets located on labels (44) in an optical target acquisition system having system data signals independent of said image data signals, said system data signals being adapted for controlling system functions, comprising the steps of:

(a) capturing an image of a label by means of an optical scanning device (154);

(b) executing said system functions by first system processor means (160) in accordance with said system data signals;

(c) receiving said image by second target processor means (174, 180, 182, 194) separate from said first system processor means;

(d) detecting said target in said image by said second target processor means (174, 180, 182, 194) to provide an acquisition target detection signal in accordance with said detecting; and

(e) determining the orientation of the label in the captured image by third processor means (190) separate from said first and second processor means.

49. The optical target acquisition method of claim 48, comprising the further steps of:

(f) receiving and transmitting said image data signals from said optical scanning device by first image data bus means (172); and,

(g) applying said transmitted image data signals to said second target processor means (174, 180, 182, 194) by way of said first image data bus means (172) for detecting in accordance with said transmitted signals.

50. The optical target acquisition method of claim 48, comprising the further step of directly applying said detection signal to said first system processor means (160) by way of second system bus means (170) coupled to said first system processor means (160).

51. The optical target acquisition method of claim 50, wherein said first image bus means (172) is independent of said second system bus means (170).
52. The optical target acquisition method of claim 48, wherein said executing of step (b) and said detecting of step (d) occur simultaneously.
53. The optical target acquisition method of claim 48, wherein step (d) further comprises detecting a plurality of differing target configurations by a corresponding plurality of said second target processor means (174, 180, 182, 194).
54. The optical target acquisition method of claim 53, wherein said differing target configurations comprise a rectangular target configuration and a circular target configuration.
55. The optical target acquisition method of claim 48, wherein said second target processor means (174, 180, 182, 194) comprises fourth prerecognition processor means (174) for preliminary detecting of said optical target and fifth digital signal processor means (180, 182, 194) for further detecting of said optical target, said fifth digital signal processor means being independent of said fourth prerecognition processor means (174).
56. The optical target acquisition method of claim 48, wherein a plurality of differing target transforms are applied to a selected optical target to provide a plurality of transformed target images, including means (240, 242) for detecting a selected target having a selected target transform applied to said selected target, comprising the further steps of:
- (h) providing a plurality of template images representative of said plurality of transformed target images; and,
- (i) selecting a template image of said plurality of template images in accordance with said selected target transform.
57. The optical target acquisition method of claim 56, comprising the further steps of:
- (j) comparing a selected transformed target image and said selected template image to provide said detection signal; and,
- (k) acquiring said selected transformed target in accordance with said detection signal.
58. The optical target acquisition method of claim 56, further including a conveyor surface (20) for disposing an object (42) upon said conveyor surface (20)

to scan said object with image means (50, 154) and process said object (42) according to optically encoded information disposed upon said object (42) wherein step (i) comprises the step of selecting a template image in accordance with the distance from said image means (50, 154) to said object (42).

59. The optical target acquisition method of claim 58, comprising the further steps of:

(l) decoding said encoded information disposed upon said object in accordance with signals from said image means (50, 154); and,

(m) diverting said object in accordance with said decoded information.

Patentansprüche

1. System (10), 100) zur Erfassung optischer Ziele, das mehrere optische Ziele erfaßt, die sich auf Etiketten (44) befinden und wenigstens erste und zweite unterschiedliche Zielkonfigurationen und Zieldatensignale, die die unterschiedlichen Zielkonfigurationen darstellen, besitzen, mit:

einer Einrichtung (154) zum Aufnehmen eines Bildes eines Etiketts;

einer ersten Zielprozessoreinrichtung (174, 180, 182) zum Empfangen des Bildes, das die Zieldatensignale enthält, und zum Erfassen der ersten Zielkonfiguration in Übereinstimmung mit den Zieldatensignalen, um ein erstes Zielerfassungssignal zu erzeugen;

einer zweiten Zielprozessoreinrichtung (174, 180, 182), die von der ersten Zielprozessoreinrichtung getrennt ist und das Bild empfängt, das die Zieldatensignale enthält, und die zweite Zielkonfiguration in Übereinstimmung mit den Zieldatensignalen erfaßt, um ein zweites Zielerfassungssignal zu erzeugen; und

einer dritten Prozessoreinrichtung (190), die von der ersten und von der zweiten Prozessoreinrichtung getrennt ist und die Orientierung des Etiketts in dem aufgenommenen Bild bestimmt.

2. System zur Erfassung optischer Ziele nach Anspruch 1, ferner mit einer Erfassungseinrichtung (190, 194), die an die ersten und zweiten Prozessoreinrichtungen (174, 180, 182) gekoppelt ist, um die ersten und zweiten Erfassungssignale von der ersten bzw. der zweiten Zielprozessoreinrichtung (174, 180, 182) zu empfangen und das Ziel in Übereinstimmung mit den ersten und zweiten Erfassungssignalen zu erfassen.

3. System zur Erfassung optischer Ziele nach Anspruch 2, wobei die ersten und zweiten unterschiedlichen Zielkonfigurationen mit zugeordneten Informationen versehen sind; die in Übereinstimmung mit ersten und zweiten unterschiedlichen Codierungsverfahren codiert sind, wobei die Erfassungseinrichtung (190, 194) enthält:

unterschiedliche erste und zweite Decodierungseinrichtungen zum Decodieren der Informationen, die in Übereinstimmung mit dem ersten bzw. mit dem zweiten unterschiedlichen Codierungsverfahren codiert sind; und eine Einrichtung zum Wählen einer der unterschiedlichen ersten und zweiten Decodierungseinrichtungen in Übereinstimmung mit dem empfangenen ersten und zweiten Erfassungssignal.

4. System zur Erfassung optischer Ziele nach Anspruch 2, ferner mit einer Zielsignal-Übertragungseinrichtung (172), die an die ersten und zweiten Zielprozessoreinrichtungen (174, 180, 182) gekoppelt ist, um die Zieldatensignale zu empfangen und die Zieldatensignale an die erste und an die zweite Zielprozessoreinrichtung (174, 180, 182) zu übertragen.

5. System zur Erfassung optischer Ziele nach Anspruch 4, wobei die erste und die zweite Zielprozessoreinrichtung (174, 180, 182) gleichzeitig jeweils völlig gleiche Zieldatensignale von der Zielsignal-Übertragungseinrichtung (172) empfangen und verarbeiten.

6. System zur Erfassung optischer Ziele nach Anspruch 4, ferner mit einer Systembuseinrichtung (170), die von der Zielsignal-Übertragungseinrichtung (172) unabhängig ist und die ersten und zweiten Zielprozessoreinrichtungen (174, 180, 182) an die Erfassungseinrichtung (190, 194) koppelt.

7. System zur Erfassung optischer Ziele nach Anspruch 6, ferner mit einer Systemprozessoreinrichtung (160), die von den ersten und zweiten Zielprozessoreinrichtungen (174, 180, 182) getrennt ist und an die Systembuseinrichtung (170) gekoppelt ist, um Systemdatensignale von der Systembuseinrichtung (170) zu empfangen und um Systemfunktionen in Übereinstimmung mit den empfangenen Systemdatensignalen auszuführen.

8. System zur Erfassung optischer Ziele nach Anspruch 7, wobei die Erfassung der ersten und zweiten Zielkonfigurationen und die Ausführung der Systemfunktionen gleichzeitig erfolgen.

9. System zur Erfassung optischer Ziele nach An-

spruch 1, wobei wenigstens eine der ersten und zweiten unterschiedlichen Zielkonfigurationen eine rechtwinklige Zielkonfiguration enthält.

10. System zur Erfassung optischer Ziele nach Anspruch 1, wobei wenigstens eine der ersten und zweiten verschiedenen Zielkonfigurationen eine kreisförmige Zielkonfiguration enthält.

11. System zur Erfassung optischer Ziele nach Anspruch 1, wobei die ersten und zweiten verschiedenen Zielkonfigurationen eine rechtwinklige Zielkonfiguration bzw. eine kreisförmige Zielkonfiguration umfassen.

12. System zur Erfassung optischer Ziele nach Anspruch 11, wobei die rechtwinklige Zielkonfiguration aus einem Strichcode gebildet ist.

13. System zur Erfassung optischer Ziele nach Anspruch 12, wobei die kreisförmige Zielkonfiguration aus mehreren konzentrischen Ringen gebildet ist.

14. System zur Erfassung optischer Ziele nach Anspruch 1, wobei mehrere verschiedene Zieltransformationen auf das optische Ziel angewendet werden, um mehrere transformierte Zielbilder zu erzeugen, ferner mit:

mehreren Schablonenbildern, die die mehreren transformierten Zielbilder repräsentieren; und eine Einrichtung (254) zum Wählen eines der mehreren Schablonenbilder in Übereinstimmung mit einer gewählten Zieltransformation.

15. System zur Erfassung optischer Ziele nach Anspruch 14, ferner mit:

einer Einrichtung (240, 242, 248) zum Vergleichen des gewählten Schablonenbildes mit den Zieldatensignalen, um in Übereinstimmung mit dem Vergleich ein Erfassungssignal zu erzeugen; und eine Einrichtung (190, 194) zum Erfassen des Ziels in Übereinstimmung mit dem Erfassungssignal.

16. System zur Erfassung optischer Ziele nach Anspruch 14, wobei die verschiedenen Zieltransformationen unterschiedliche Zielvergrößerungen umfassen.

17. System zur Erfassung optischer Ziele nach Anspruch 16, ferner mit einer Beförderungsoberfläche (20) zum Anordnen eines Objekts (42) auf der Beförderungsoberfläche (20), um das Objekt (42) in Übereinstimmung mit optisch codierten Informatio-

nen zu verarbeiten, die auf dem Objekt (42) angeordnet sind, wobei die Einrichtung (254) zum Wählen des Schablonenbildes eine Einrichtung enthält, die in Übereinstimmung mit dem Abstand zwischen dem Objekt (42) und der Abbildungseinrichtung (154) wählt, um die Zieldatensignale zu erzeugen.

18. System zur Erfassung optischer Ziele nach Anspruch 17, ferner mit:

einer Decodierungseinrichtung (190, 194) zum Decodieren der an dem Objekt angeordneten optisch codierten Informationen; und einer Einrichtung zum Lenken des Objekts in Übereinstimmung mit der Decodierungseinrichtung.

19. System zur Erfassung optischer Ziele, das auf Etiketten (44) angeordnete optische Ziele erfaßt, wobei das System Systemdatensignale, die von Bildatensignalen unabhängig sind, besitzt, um Systemfunktionen zu steuern, ferner mit:

einer Vorrichtung (154) zum optischen Abtasten, um ein Bild eines Etiketts aufzunehmen; einer ersten Systemprozessoreinrichtung (160), die eine Einrichtung zum Empfangen der Systemdatensignale enthält, um die Systemfunktionen von der ersten Systemprozessoreinrichtung (160) in Übereinstimmung mit den Systemdatensignalen auszuführen; einer zweiten Zielprozessoreinrichtung (174, 180, 182, 194), die von der ersten Systemprozessoreinrichtung getrennt ist, um das Bild zu empfangen und das optische Ziel zu erfassen, um ein Zielerfassungssignal zu erzeugen; wobei die zweite Zielprozessoreinrichtung (174, 180, 182, 194) eine Einrichtung (170) zum Übertragen des Erfassungssignals an die erste Systemprozessoreinrichtung (160) besitzt; und einer dritten Prozessoreinrichtung (190), die von der ersten und von der zweiten Prozessoreinrichtung getrennt ist und die Orientierung des Etiketts im aufgenommenen Bild bestimmt.

20. System zur Erfassung optischer Ziele nach Anspruch 19, wobei die Einrichtung (170) zum Übertragen des Erfassungssignals eine erste Systembuseinrichtung (170) umfaßt, die an die erste Systemprozessoreinrichtung (160) gekoppelt ist, um das Erfassungssignal von der zweiten Zielprozessoreinrichtung (174, 180, 182, 194) direkt in die erste Systemprozessoreinrichtung (160) einzugeben.

21. System zur Erfassung optischer Ziele nach Anspruch 20, ferner mit einer zweiten Bilddatenbuseinrichtung (172), die an die zweite Zielprozessoreinrichtung (174, 180, 182, 194) gekoppelt ist, um die Bilddatensignale von der Vorrichtung (154) zum optischen Abtasten zu empfangen und die Bilddatensignale in die zweite Zielprozessoreinrichtung einzugeben.

22. System zur Erfassung optischer Ziele nach Anspruch 21, wobei die zweite Bilddatenbuseinrichtung (172) von der ersten Systembuseinrichtung (170) unabhängig ist.

23. System zur Erfassung optischer Ziele nach Anspruch 19, wobei die Ausführung der Systemfunktionen und die Erfassung des optischen Ziels in der ersten bzw. in der zweiten Prozessoreinrichtung (160; 174, 180, 182, 194) gleichzeitig erfolgen.

24. System zur Erfassung optischer Ziele nach Anspruch 19, das ferner mehrere der zweiten Zielprozessoreinrichtungen (174, 180, 182, 194) zum Erfassen einer entsprechenden Mehrzahl unterschiedlicher Zielkonfigurationen der optischen Ziele enthält.

25. System zur Erfassung optischer Ziele nach Anspruch 24, ferner mit einer zweiten Bilddatenbuseinrichtung zum Übertragen der Bilddatensignale, wobei jede der mehreren zweiten Zielprozessoreinrichtungen (174, 180, 182, 194) an die zweite Bilddatenbuseinrichtung (196) gekoppelt ist, um Bilddatensignale von der Bilddatenbuseinrichtung zu empfangen und die Bilddatensignale gleichzeitig zu verarbeiten.

26. System zur Erfassung optischer Ziele nach Anspruch 24, wobei die unterschiedlichen Zielkonfigurationen eine rechteckige Zielkonfiguration und eine kreisförmige Zielkonfiguration umfassen.

27. System zur Erfassung optischer Ziele nach Anspruch 26, wobei die unterschiedlichen Zielkonfigurationen eine Strichcode-Konfiguration und eine Konfiguration aus konzentrischen Ringen enthalten.

28. System zur Erfassung optischer Ziele nach Anspruch 19, wobei die zweite Zielprozessoreinrichtung (174, 180, 182, 194) eine vierte Vorerkennungsprozessoreinrichtung (174, 180, 182) zum vorhergehenden Erfassen des optischen Ziels sowie eine fünfte digitale Signalprozessoreinrichtung (194) zum weiteren Bestimmen des optischen Ziels enthält, wobei die fünfte digitale Signalprozessoreinrichtung von der vierten Vorerkennungsprozessoreinrichtung (174, 180, 182) unabhängig ist.

29. System zur Erfassung optischer Ziele nach Anspruch 28, das ferner mehrere der vierten Vorerkennungsprozessoreinrichtungen (174, 180, 182) enthält, wobei jede der mehreren vierten Vorerkennungsprozessoreinrichtungen (174, 180, 182) an die fünfte digitale Signalprozessoreinrichtung (194) gekoppelt ist, um die Zielerfassungssignale von der vierten Vorerkennungsprozessoreinrichtung (174, 180, 182) zu empfangen und die Zielerfassungssignale in die fünfte digitale Signalprozessoreinrichtung (194) einzugeben.

nungsprozessoreinrichtungen (174, 180, 182) enthält.

30. System zur Erfassung optischer Ziele nach Anspruch 29, wobei die fünfte Prozessoreinrichtung (194) ferner optisch codierte Informationen decodiert, die dem optischen Ziel zugeordnet sind.

31. System zur Erfassung optischer Ziele nach Anspruch 19, wobei auf ein ausgewähltes optisches Ziel mehrere unterschiedliche Zieltransformationen angewendet werden, um mehrere transformierte Zielbilder zu erzeugen, mit einer Einrichtung (174, 180) zum Erfassen eines gewählten Ziels mit einer gewählten Zieltransformation, die auf das gewählte Ziel angewendet wird, ferner mit:

mehreren Schablonenbildern, die die mehreren transformierten Zielbilder repräsentieren; und
einer Einrichtung (254) zum Wählen eines der mehreren Schablonenbilder in Übereinstimmung mit der gewählten Zieltransformation.

32. System zur Erfassung optischer Ziele nach Anspruch 31, ferner mit:

einer Einrichtung (240, 242, 248) zum Vergleichen eines gewählten transformierten Zielbildes mit dem gewählten Schablonenbild und zum Erzeugen des Erfassungssignals in Übereinstimmung mit dem Vergleich; und
einer Einrichtung (190, 194) zum Erfassen des gewählten Ziels in Übereinstimmung mit dem Erfassungssignal.

33. System zur Erfassung optischer Ziele nach Anspruch 31, ferner mit einer Beförderungsoberfläche (20) zum Anordnen eines Objekts (42) auf der Beförderungsoberfläche (20), um das Objekt (42) mit einer Abbildungseinrichtung (50, 154) abzutasten und um das Objekt (42) in Übereinstimmung mit optisch codierten Informationen, die auf dem Objekt (42) angeordnet sind, zu verarbeiten, wobei die Einrichtung (254) zum Wählen eines Schablonenbildes eine Einrichtung (254) zum Wählen eines Schablonenbildes in Übereinstimmung mit dem Abstand von der Abbildungseinrichtung (50) zum Objekt (42) enthält.

34. System zur Erfassung optischer Ziele nach Anspruch 33, ferner mit:

einer Einrichtung (190, 194) zum Decodieren von Informationen, die auf dem Objekt angeordnet sind; und
einer Einrichtung zum Lenken des Objekts in Übereinstimmung mit den decodierten Infor-

mationen.

35. Verfahren zur Erfassung optischer Ziele, um mehrere optische Ziele zu erfassen, die sich auf Etiketten (44) befinden, wobei die Ziele unterschiedliche Zielkonfigurationen besitzen und wobei den Zielen codierte Informationen zugeordnet sind, mit den folgenden Schritten:

(a) Aufnehmen eines Bildes eines Etiketts und Erzeugen von Bilddaten einschließlich Signalen, die eine erste und eine zweite unterschiedliche Zielkonfiguration repräsentieren;
(b) Empfangen und Übertragen der Bilddatensignale durch eine Bilddatensignal-Übertragungseinrichtung (172);
(c) Empfangen der übertragenen Bilddatensignale und Erfassen der ersten Zielkonfiguration in Übereinstimmung mit den übertragenen Zieldatensignalen durch die erste Prozessoreinrichtung (174, 180, 182), die an die Bilddatensignal-Übertragungseinrichtung gekoppelt ist, um ein erstes Zielerfassungssignal zu erzeugen;
(d) Empfangen der übertragenen Bilddatensignale und Erfassen der zweiten Zielkonfiguration in Übereinstimmung mit den übertragenen Zieldatensignalen, um durch die zweite Prozessoreinrichtung (174, 180, 182), die von der ersten Prozessoreinrichtung (174, 180, 182) getrennt ist und an die Bilddatensignal-Übertragungseinrichtung (172) gekoppelt ist, ein zweites Zielerfassungssignal zu erzeugen; und
(e) Bestimmen der Orientierung des Etiketts in dem aufgenommenen Bild durch eine dritte Prozessoreinrichtung (190), die von der ersten und der zweiten Prozessoreinrichtung getrennt ist.

36. Verfahren zur Erfassung optischer Ziele nach Anspruch 35, ferner mit den folgenden Schritten:

(f) Empfangen der ersten und zweiten Erfassungssignale von der ersten bzw. der zweiten Prozessoreinrichtung (174, 180, 182) durch die Erfassungseinrichtung (190, 194), die an die erste und an die zweite Prozessoreinrichtung gekoppelt ist; und
(g) Erfassen einer der ersten und zweiten Zielkonfigurationen in Übereinstimmung mit den ersten und zweiten Erfassungssignalen.

37. Verfahren zur Erfassung optischer Ziele nach Anspruch 36, ferner mit den folgenden Schritten:

h) Wählen einer ersten oder einer zweiten Decodierungseinrichtung in Übereinstimmung mit den erfaßten ersten und zweiten Erfassungssi-

gnalen; und

(i) Decodieren der zugeordneten codierten Informationen der Ziele durch die ersten und zweiten Decodierungseinrichtungen.

38. Verfahren zur Erfassung optischer Ziele nach Anspruch 36, ferner mit dem Schritt des gleichzeitigen Verarbeitens derselben übertragenen Zieldatensignale im Schritt (c) und im Schritt (d).

39. Verfahren zur Erfassung optischer Ziele nach Anspruch 36, ferner mit einer Systembuseinrichtung (170), die von der Zielsignalübertragungseinrichtung (172) unabhängig ist, und die ersten und zweiten Prozessoreinrichtungen (174, 180, 182) an Einrichtungen (190, 194) zum Ausführen der Erfassung des Schrittes (g) koppelt.

40. Verfahren zur Erfassung optischer Ziele nach Anspruch 39, ferner mit den Schritten des Empfangens von Systemdatensignalen von der Systembuseinrichtung (170) und des Ausführens von Systemfunktionen in Übereinstimmung mit den empfangenen Systemdatensignalen durch die Systemprozessoreinrichtung (160), die von der ersten und der zweiten Prozessoreinrichtung (174, 180, 182) getrennt ist und an die Systembuseinrichtung (170) gekoppelt ist.

41. Verfahren zur Erfassung optischer Ziele nach Anspruch 40, wobei die Schritte des Erfassens des Ziels und des Ausführens der Systemfunktionen gleichzeitig erfolgen.

42. Verfahren zur Erfassung optischer Ziele nach Anspruch 35, wobei die ersten und zweiten Zielkonfigurationen eine rechteckige Zielkonfiguration und eine kreisförmige Zielkonfiguration umfassen.

43. Verfahren zur Erfassung optischer Ziele nach Anspruch 42, bei dem die rechteckige Zielkonfiguration aus einem Strichcode gebildet ist und die kreisförmige Zielkonfiguration aus mehreren konzentrischen Ringen gebildet ist.

44. Verfahren zur Erfassung optischer Ziele nach Anspruch 35, bei dem auf das optische Ziel mehrere unterschiedliche Zieltransformationen angewendet werden, um mehrere transformierte Zielbilder zu erzeugen, ferner mit den folgenden Schritten:

(j) Vorsehen mehrerer Schablonenbilder, die die mehreren transformierten Zielbilder repräsentieren;

(k) Wählen eines Schablonenbildes der mehreren Schablonenbilder in Übereinstimmung mit einer gewählten Zieltransformation; und

(l) Vergleichen des gewählten Schablonenbil-

des mit den Zieldatensignalen, um das optische Ziel in Übereinstimmung mit dem Vergleich zu erfassen.

45. Verfahren zur Erfassung optischer Ziele nach Anspruch 44, bei dem die unterschiedlichen Zieltransformationen unterschiedliche Zielvergrößerungen umfassen.

46. Verfahren zur Erfassung optischer Ziele nach Anspruch 45, mit dem weiteren Schritt des Anordnens eines Objekts (42) auf einer Beförderungsoberfläche (20), um das Objekt in Übereinstimmung mit optisch codierten Informationen, die an dem Objekt (42) angeordnet sind und durch eine optische Abbildungseinrichtung (50) abgebildet werden, zu verarbeiten, wobei der Schritt des Wählens des Schablonenbildes den Schritt des Wählens in Übereinstimmung mit dem Abstand zwischen dem Objekt und der Abbildungseinrichtung (50) enthält.

47. Verfahren zur Erfassung optischer Ziele nach Anspruch 46, ferner mit den folgenden Schritten:

(m) Decodieren der an dem Objekt (42) angeordneten Informationen; und
(n) Lenken des Objekts in Übereinstimmung mit den decodierten Informationen.

48. Verfahren zur Erfassung optischer Ziele, die sich auf Etiketten (4) befinden, in einem System zur Erfassung optischer Ziele, das Systemdatensignale besitzt, die von Bilddatensignalen unabhängig sind, wobei die Systemdatensignale für die Steuerung von Systemfunktionen geeignet sind, ferner mit dem folgenden Schritten:

(a) Aufnehmen eines Bildes eines Etiketts durch eine Vorrichtung (154) zum optischen Abtasten;

(b) Ausführen der Systemfunktionen durch die erste Systemprozessoreinrichtung (160) in Übereinstimmung mit den Systemdatensignalen;

(c) Empfangen des Bildes durch die zweite Zielprozessoreinrichtung (174, 180, 182, 194), die von der ersten Systemprozessoreinrichtung getrennt ist;

(d) Erfassen des Ziels in dem Bild durch die zweite Zielprozessoreinrichtung (174, 180, 182, 194), um ein Zielerfassungssignal in Übereinstimmung mit der Erfassung zu erzeugen; und

(e) Bestimmen der Orientierung des Etiketts in dem aufgenommenen Bild durch eine dritte Prozessoreinrichtung (190), die von den ersten und zweiten Prozessoreinrichtungen getrennt ist.

49. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, ferner mit den folgenden Schritten:

(f) Empfangen und Übertragen der Bilddatensignale von der Vorrichtung zum optischen Abtasten durch die erste Bilddatenbuseinrichtung (172); und

(g) Eingeben der übertragenen Bilddatensignale in die zweite Zielprozessoreinrichtung (174, 180, 182, 194) mittels der ersten Bilddatenbuseinrichtung (172), um eine Erfassung in Übereinstimmung mit den übertragenen Signalen auszuführen.

50. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, mit dem weiteren Schritt des direkten Eingebens des Erfassungssignals in die erste Systemprozessoreinrichtung (160) über die zweite Systembuseinrichtung (170), die an die erste Systemprozessoreinrichtung (160) gekoppelt ist.

51. Verfahren zur Erfassung optischer Ziele nach Anspruch 50, wobei die erste Bilddatenbuseinrichtung (172) von der zweiten Systembuseinrichtung (170) unabhängig ist.

52. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, bei dem die Ausführung des Schrittes (b) und des Erfassungsschrittes (d) gleichzeitig erfolgt.

53. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, bei dem der Schritt (d) ferner das Erfassen mehrerer unterschiedlicher Zielkonfigurationen durch eine entsprechende Mehrzahl der zweiten Zielprozessoreinrichtungen (174, 180, 182, 194) umfaßt.

54. Verfahren zur Erfassung optischer Ziele nach Anspruch 53, bei dem die unterschiedlichen Zielkonfigurationen eine rechtwinklige Zielkonfiguration und eine kreisförmige Zielkonfiguration umfassen.

55. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, bei dem die zweite Zielprozessoreinrichtung (174, 180, 182, 194) eine vierte Vorerkennungsprozessoreinrichtung (174) zum vorherigen Erfassen des optischen Ziels sowie eine fünfte digitale Signalprozessoreinrichtung (180, 182, 194) zum weiteren Erfassen des optischen Ziels enthält, wobei die fünfte digitale Signalprozessoreinrichtung von der vierten Vorerkennungsprozessoreinrichtung (174) unabhängig ist.

56. Verfahren zur Erfassung optischer Ziele nach Anspruch 48, bei dem mehrere unterschiedliche Zieltransformationen auf ein gewähltes optisches Ziel angewendet werden, um mehrere transformierte

Zielbilder zu erzeugen, mit einer Einrichtung (240, 242) zum Erfassen eines gewählten Ziels mit einer gewählten Zieltransformation, die auf das gewählte Ziel angewendet wird, ferner mit den folgenden Schritten:

(h) Vorsehen mehrerer Schablonenbilder, die die mehreren transformierten Zielbilder repräsentieren; und

(i) Wählen eines der mehreren Schablonenbilder in Übereinstimmung mit der gewählten Zieltransformation.

57. Verfahren zur Erfassung optischer Ziele nach Anspruch 56, ferner mit den folgenden Schritten:

(j) Vergleichen eines gewählten transformierten Zielbildes und des gewählten Schablonenbildes, um das Erfassungssignal zu erzeugen; und

(k) Erfassen des gewählten transformierten Ziels in Übereinstimmung mit dem Erfassungssignal.

58. Verfahren zur Erfassung optischer Ziele nach Anspruch 56, ferner mit einer Beförderungsoberfläche (20) zum Anordnen eines Objekts (42) auf der Beförderungsoberfläche (20), um das Objekt mit einer Abbildungseinrichtung (50, 154) abzutasten und das Objekt (42) in Übereinstimmung mit optisch codierten Informationen, die an dem Objekt (42) angeordnet sind, zu verarbeiten, wobei der Schritt (i) den Schritt des Wählens eines Schablonenbildes in Übereinstimmung mit dem Abstand der Abbildungseinrichtung (50, 154) von dem Objekt (42) enthält.

59. Verfahren zur Erfassung optischer Ziele nach Anspruch 58, ferner mit den folgenden Schritten:

(l) Decodieren der codierten Informationen, die an dem Objekt angeordnet sind, in Übereinstimmung mit Signalen von der Abbildungseinrichtung (50, 154); und

(m) Lenken des Objekts in Übereinstimmung mit den decodierten Informationen.

Revendications

1. Système d'acquisition de cibles optiques (10, 100) pour la détection d'une pluralité de cibles optiques se trouvant sur des étiquettes (44), les cibles ayant au moins des première et seconde configurations de cible différentes et des signaux de données de cible représentatifs desdites configurations de cible différentes, comportant :

- des moyens (154) pour saisir une image d'une étiquette ;
des premiers moyens de traitement de cible (174, 180, 182) pour recevoir ladite image comportant lesdits signaux de données de cible et détectant ladite première configuration de cible en fonction desdits signaux de données de cible pour fournir un premier signal de détection de cible d'acquisition ;
des seconds moyens de traitement de cible (174, 180, 182) séparés desdits premiers moyens de traitement de cible pour recevoir ladite image comprenant lesdits signaux de données de cible et détectant ladite seconde configuration de cible en fonction desdits signaux de données de cible pour fournir un second signal de détection de cible d'acquisition ; et
des troisièmes moyens de traitement (190) séparés desdits premier et second moyens de traitement, pour déterminer l'orientation de l'étiquette dans l'image saisie.
2. Système d'acquisition de cibles optiques selon la revendication 1, comprenant en outre des moyens de détection (190, 194) couplés auxdits premier et second moyens de traitement (174, 180, 182) pour recevoir lesdits premier et second signaux de détection provenant desdits premier et second moyens de traitement de cible (174, 180, 182) et acquérir ladite cible en fonction desdits premier et second signaux de détection.
 3. Système d'acquisition de cibles optiques selon la revendication 2, dans lequel lesdites première et seconde configurations de cible différentes sont fournies avec des informations associées codées selon des premier et second procédés de codage différents, lesdits moyens de détection (190, 194) comprenant :
des premier et second moyens de décodage différents pour décoder respectivement lesdites informations codées selon lesdits premier et second procédés de codage différents ; et
des moyens pour sélectionner l'un desdits premier et second moyens de décodage différents en fonction des desdits premier et second signaux de détection reçus.
 4. Système d'acquisition de cibles optiques selon la revendication 2, comprenant en outre des moyens de transmission de signaux de cible (172) couplés auxdits premier et second moyens de traitement de cible (174, 180, 182) pour recevoir lesdits signaux de données de cible et transmettre lesdits signaux de données de cible auxdits premier et second moyens de traitement de cible (174, 180, 182).
 5. Système d'acquisition de cibles optiques selon la revendication 4 dans lequel lesdits premier et second moyens de traitement de cible (174, 180, 182) reçoivent et traitent chacun simultanément des signaux de données de cible identiques provenant desdits moyens de transmission de signaux de cible (172).
 6. Système d'acquisition de cibles optiques selon la revendication 4, comprenant en outre un bus système (170) indépendant desdits moyens de transmission de signaux de cible (172) pour coupler lesdits premier et second moyens de traitement de cible (174, 180, 182) auxdits moyens de détection (190, 194).
 7. Système d'acquisition de cibles optiques selon la revendication 6, comprenant en outre des moyens de traitement de système (160) séparés desdits premier et second moyens de traitement de cible (174, 180, 182) et couplés audit bus système (170) pour recevoir des signaux de données système provenant dudit bus système (170) et exécuter des fonctions système en fonction desdits signaux de données système reçus.
 8. Système d'acquisition de cibles optiques selon la revendication 7 dans lequel ladite détection desdites première et seconde configurations de cible et ladite exécution desdites fonctions système sont effectuées simultanément.
 9. Système d'acquisition de cibles optiques selon la revendication 1, dans lequel au moins l'une desdites première et seconde configurations de cible différentes comprend une configuration de cible rectangulaire.
 10. Système d'acquisition de cibles optiques selon la revendication 1, dans lequel au moins une desdites première et seconde configurations de cible différentes comprend une configuration de cible circulaire.
 11. Système d'acquisition de cibles optiques selon la revendication 1, dans lequel lesdites première et seconde configurations de cible différentes comprennent une configuration de cible rectangulaire et une configuration de cible circulaire.
 12. Système d'acquisition de cibles optiques selon la revendication 11 dans lequel ladite configuration de cible rectangulaire est formée d'un code à barres.
 13. Système d'acquisition de cibles optiques selon la revendication 12, dans lequel ladite configuration de cible circulaire est formée d'une pluralité d'anneaux concentriques.

14. Système d'acquisition de cibles optiques selon la revendication 1 dans lequel une pluralité de transformées de cible différentes sont appliquées auxdites cibles optiques pour fournir une pluralité d'images de cible transformées, comprenant en outre :

une pluralité d'images modèles représentatives de ladite pluralité d'images de cible transformées ; et
des moyens (254) pour sélectionner une image modèle dans ladite pluralité d'images modèles en fonction d'une transformée de cible sélectionnée.

15. Système d'acquisition de cibles optiques selon la revendication 14 comprenant en outre :

des moyens (240, 242, 248) pour comparer ladite image modèle sélectionnée et lesdits signaux de données de cible pour fournir un signal de détection en fonction de ladite comparaison ; et
des moyens (190, 194) pour acquérir ladite cible en fonction dudit signal de détection.

16. Système d'acquisition de cibles optiques selon la revendication 14 dans lequel lesdites transformées de cible différentes comprennent des agrandissements de cible différents.

17. Système d'acquisition de cibles optiques selon la revendication 16 comprenant en outre une surface de convoyage (20) permettant de disposer un objet (42) sur ladite surface de convoyage (20) pour traiter ledit objet (42) en fonction des informations codées optiquement disposées sur ledit objet (42) dans lequel lesdits moyens (254) pour sélectionner ladite image modèle comprennent des moyens pour sélectionner en fonction de la distance entre ledit objet (42) et des moyens d'image (154) permettant de fournir lesdits signaux de données de cible.

18. Système d'acquisition de cibles optiques selon la revendication 17 comprenant en outre :

des moyens de décodage (190, 194) pour décoder lesdites informations codées optiquement disposées sur ledit objet ; et
des moyens pour dévier ledit objet en fonction desdits moyens de décodage.

19. Système d'acquisition de cibles optiques pour la détection de cibles optiques disposées sur des étiquettes (44), ledit système ayant des signaux de données système indépendants desdits signaux de données d'image pour commander des fonctions système, et comprenant en outre :

un dispositif de balayage optique (154) pour saisir une image d'une étiquette ;
des premiers moyens de traitement système (160) comprenant des moyens pour recevoir lesdits signaux de données système permettant d'exécuter lesdites fonctions système par lesdits premiers moyens de traitement système (160) en fonction desdits signaux de données système ;
des seconds moyens de traitement de cible (174, 180, 182, 194) séparés desdits premiers moyens de traitement de système pour recevoir ladite image et détecter ladite cible optique afin de fournir un signal de détection de cible d'acquisition ;
lesdits seconds moyens de traitement de cible (174, 180, 182, 194) ayant des moyens (170) pour transmettre ledit signal de détection auxdits premiers moyens de traitement système (160) ; et
des troisièmes moyens de traitement (190) séparés desdits premier et second moyens de traitement, pour déterminer l'orientation de l'étiquette dans l'image saisie.

20. Système d'acquisition de cibles optiques selon la revendication 19, dans lequel lesdits moyens (170) pour transmettre ledit signal de détection comprend un premier bus système (170) couplé auxdits premiers moyens de traitement système (160) pour appliquer directement ledit signal de détection provenant desdits seconds moyens de traitement de cible (174, 180, 182, 194) auxdits premiers moyens de traitement système (160).

21. Système d'acquisition de cibles optiques selon la revendication 20, comprenant en outre un second bus de données d'image (172) couplé auxdits seconds moyens de traitement de cible (174, 180, 182, 194) pour recevoir lesdits signaux de données d'image provenant dudit dispositif de balayage optique (154) et appliquer lesdits signaux de données d'image auxdits seconds moyens de traitement de cible.

22. Système d'acquisition de cibles optiques selon la revendication 21, dans lequel ledit second bus d'image (172) est indépendant dudit premier bus système (170).

23. Système d'acquisition de cibles optiques selon la revendication 19, dans lequel ladite exécution desdites fonctions système et ladite détection de ladite cible optique sont effectuées simultanément à l'intérieur desdits premier et second moyens de traitement (160 ; 174, 180, 182, 194) respectivement.

24. Système d'acquisition de cibles optiques selon la

revendication 19, comprenant en outre une pluralité de seconds moyens de traitement de cible (174, 180, 182, 194) pour détecter une pluralité correspondante de configurations de cible différentes desdites cibles optiques.

25. Système d'acquisition de cibles optiques selon la revendication 24, comprenant en outre un second bus de données d'image (172) pour transmettre lesdits signaux de données d'image, dans lequel chacun de ladite pluralité de seconds moyens de traitement de cible (174, 180, 182, 194) est couplé audit second bus de données d'image (196) afin de recevoir des signaux de données d'image provenant dudit bus de données d'image et traiter simultanément lesdits signaux de données d'image.

26. Système d'acquisition de cibles optiques selon la revendication 24, dans lequel lesdites configurations de cible différentes comprennent une configuration de cible rectangulaire et une configuration circulaire.

27. Système d'acquisition de cibles optiques selon la revendication 26, dans lequel lesdites configurations de cible différentes comprennent une configuration de code à barres et une configuration d'anneaux concentriques.

28. Système d'acquisition de cibles optiques selon la revendication 19, dans lequel lesdits seconds moyens de traitement de cible (174, 180, 182, 194) comprennent des quatrièmes moyens de traitement de pré-reconnaissance (174, 180, 182) pour une détection préliminaire de ladite cible optique et des cinquièmes moyens de traitement de signaux numériques (194) pour une détermination complémentaire de ladite cible optique, lesdits cinquièmes moyens de traitement de signaux numériques étant indépendants desdits quatrièmes moyens de traitement de pré-reconnaissance (174, 180, 182).

29. Système d'acquisition de cibles optiques selon la revendication 28, comprenant en outre une pluralité desdits quatrièmes moyens de traitement de pré-reconnaissance (174, 180, 182).

30. Système d'acquisition de cibles optiques selon la revendication 29, dans lequel lesdits cinquièmes moyens de traitement (194) décodent en outre les informations codées optiquement associées à ladite cible optique.

31. Système d'acquisition de cibles optiques selon la revendication 19, dans lequel une pluralité de transformées de cible différentes sont appliquées à une cible optique sélectionnée pour fournir une pluralité d'images de cible transformées, comprenant des

moyens (174, 180) pour détecter une cible sélectionnée ayant une transformée de cible sélectionnée appliquée à ladite cible sélectionnée, comprenant en outre :

une pluralité d'images modèle représentatives de ladite pluralité d'images de cible transformées ; et
des moyens (254) pour sélectionner une image modèle dans ladite pluralité d'images modèle en fonction de ladite transformée de cible sélectionnée.

32. Système d'acquisition de cibles optiques selon la revendication 31, comprenant en outre :

des moyens (240, 242, 248) pour comparer une image de cible transformée sélectionnée et ladite image modèle sélectionnée, et fournir ledit signal de détection en fonction de ladite comparaison ; et
des moyens (190, 194) pour acquérir ladite cible sélectionnée en fonction dudit signal de détection.

33. Système d'acquisition de cibles optiques selon la revendication 31, comprenant en outre une surface de convoyage (20) permettant de disposer un objet (42) sur ladite surface de convoyage (20) pour balayer ledit objet (42) avec des moyens d'image (50, 154) et pour traiter ledit objet (42) en fonction d'informations codées optiquement disposées sur ledit objet (42) dans lequel lesdits moyens (254) pour sélectionner une image modèle comprennent des moyens (254) pour sélectionner une image modèle en fonction de la distance entre lesdits moyens d'image (50) et ledit objet (42).

34. Système d'acquisition de cibles optiques selon la revendication 33 comprenant en outre :

des moyens (190, 194) pour décoder des informations disposées sur ledit objet ; et
des moyens pour dévier ledit objet en fonction desdites informations décodées.

35. Procédé d'acquisition de cibles optiques pour détecter une pluralité de cibles optiques disposées sur des étiquettes (44), les cibles ayant des configurations de cible et des informations codées associées différentes, comprenant les étapes suivantes :

(a) saisir une image d'une étiquette et fournir des données d'image comprenant des signaux représentatifs de première et seconde configurations de cible différentes ;
(b) recevoir et transmettre lesdits signaux de données d'image par des moyens de transmis-

- sion de signaux de données d'image (172) ;
 (c) recevoir lesdits signaux de données d'image transmis et détecter ladite première configuration de cible en fonction desdits signaux de données de cible transmis par des premiers moyens de traitement (174, 180, 182) couplés auxdits moyens de transmission de signaux de données d'image pour fournir un premier signal de détection de cible d'acquisition ;
 (d) recevoir lesdits signaux de données d'image transmis et détecter ladite seconde configuration de cible en fonction desdits signaux de données de cible transmis pour fournir un second signal de détection de cible d'acquisition par des seconds moyens de traitement (174, 180, 182) séparés des premiers moyens de traitement (174, 180, 182) et couplés auxdits moyens de transmission de signaux de données d'image (172) ; et
 (e) déterminer l'orientation de l'étiquette dans l'image saisie par des troisièmes moyens de traitement (190) séparés desdits premier et second moyens de traitement.
36. Procédé d'acquisition de cibles optiques selon la revendication 35 comprenant les étapes supplémentaires suivantes :
- (f) recevoir lesdits premier et second signaux de détection provenant desdits premier et second moyens de traitement (174, 180, 182) par des moyens de détection (190, 194) couplés auxdits premier et second moyens de traitement ; et
 (g) détecter l'une desdites première et seconde configurations de cible en fonction desdits premier et second signaux de détection.
37. Procédé d'acquisition de cibles optiques selon la revendication 36, comprenant les étapes supplémentaires suivantes :
- (h) sélectionner l'un desdits premier et second moyens de décodage en fonction desdits premier et second signaux de détection reçus ;
 (i) décoder lesdites informations codées associées desdites cibles par des premier et second moyens de décodage.
38. Procédé d'acquisition de cibles optiques selon la revendication 36 comprenant en outre une étape consistant à traiter simultanément, dans l'étape (c) et dans l'étape (d), les mêmes signaux de données de cible transmis.
39. Procédé d'acquisition de cibles optiques selon la revendication 36 comprenant en outre un bus système (170) indépendant desdits moyens de transmis-
- sion de signaux de cible (172) pour coupler lesdits premier et second moyens de traitement (174, 180, 182) audit moyen (190, 194) pour effectuer la détection de l'étape (g).
40. Procédé d'acquisition de cibles optiques selon la revendication 39 comprenant les étapes supplémentaires consistant à recevoir des signaux de données système à partir dudit bus système (170) et à exécuter des fonctions système en fonction desdits signaux de données système reçus par des moyens de traitement système (160) séparés desdits premier et second moyens de traitement (174, 180, 182) et couplés audit bus système (170).
41. Procédé d'acquisition de cibles optiques selon la revendication 40 dans lequel les étapes de détection de ladite cible et d'exécution desdites fonctions système sont effectuées simultanément.
42. Procédé d'acquisition de cibles optiques selon la revendication 35, dans lequel lesdites première et seconde configurations de cible comportent une configuration de cible rectangulaire et une configuration de cible circulaire.
43. Procédé d'acquisition de cibles optiques selon la revendication 42, dans lequel ladite configuration de cible rectangulaire est formée d'un code à barres et ladite configuration de cible circulaire est formée d'une pluralité d'anneaux concentriques.
44. Procédé d'acquisition de cibles optiques selon la revendication 35, dans lequel une pluralité de transformées de cible différentes sont appliquées à ladite cible optique pour fournir une pluralité d'images de cible transformées, comprenant les étapes supplémentaires suivantes :
- (j) fournir une pluralité d'images modèles représentatives de ladite pluralité d'images de cible transformées ;
 (k) sélectionner une image modèle dans ladite pluralité d'images modèles en fonction d'une transformée de cible sélectionnée ; et
 (l) comparer ladite image sélectionnée et lesdits signaux de données de cible pour acquérir ladite cible optique en fonction de ladite comparaison.
45. Procédé d'acquisition de cibles optiques selon la revendication 44, dans lequel lesdites transformées de cible différentes comprennent des agrandissements de cible différents.
46. Procédé d'acquisition de cibles optiques selon la revendication 45, comprenant l'étape supplémentaire consistant à déposer un objet (42) sur une surface

de convoyage (20) pour traiter ledit objet en fonction d'informations codées optiquement disposées sur ledit objet (42) représenté en image par des moyens d'image optiques (50) dans lequel l'étape de sélection de ladite image modèle comprenant l'étape de sélection en fonction de la distance entre ledit objet et lesdits moyens d'image (50).

47. Procédé d'acquisition de cibles optiques selon la revendication 46 comprenant les étapes supplémentaires suivantes :

(m) décoder lesdites informations disposées sur ledit objet (42) ; et
(n) dévier ledit objet (42) en fonction de ladite information décodée.

48. Procédé pour l'acquisition de cibles optiques disposées sur des étiquettes (44) dans un système d'acquisition de cibles optiques ayant des signaux de données système indépendants desdits signaux de données d'image, lesdits signaux de données système étant adaptés pour commander des fonctions système, comprenant les étapes suivantes :

(a) saisir une image d'une étiquette au moyen d'un dispositif de balayage optique (154) ;
(b) exécuter lesdites fonctions système par des premiers moyens de traitement système (160) en fonction desdits signaux de données système ;
(c) recevoir ladite image par des seconds moyens de traitement de cible (174, 180, 182, 194) séparés desdits premiers moyens de traitement système ;
(d) détecter ladite cible dans ladite image par lesdits seconds moyens de traitement de cible (174, 180, 182, 194) pour fournir un signal de détection de cible d'acquisition en fonction de ladite détection ; et
(e) déterminer l'orientation de l'étiquette dans l'image saisie par des troisièmes moyens de traitement (190) séparés desdits premier et second moyens de traitement.

49. Procédé d'acquisition de cibles optiques selon la revendication 48, comprenant les étapes supplémentaires suivantes :

(f) recevoir et transmettre lesdits signaux de données d'image provenant dudit dispositif de balayage optique par un premier bus de données d'image (172) ; et
(g) appliquer lesdits signaux de données d'image transmis auxdits seconds moyens de traitement de cible (174, 180, 182, 194) au moyen dudit premier bus de données d'image (172) pour détecter en fonction desdits signaux trans-

mis.

50. Procédé d'acquisition de cibles optiques selon la revendication 48 comprenant l'étape supplémentaire consistant à appliquer directement ledit signal de détection auxdits premiers moyens de traitement système (160) par l'intermédiaire d'un second bus système (170) couplé auxdits premiers moyens de traitement système (160).

51. Procédé d'acquisition de cibles optiques selon la revendication 50, dans lequel ledit premier bus d'image (172) est indépendant dudit second bus système (170).

52. Procédé d'acquisition de cibles optiques selon la revendication 48 dans lequel ladite exécution de l'étape (b) et ladite détection de l'étape (d) sont effectuées simultanément.

53. Procédé d'acquisition de cibles optiques selon la revendication 48, dans lequel l'étape (d) comprend en outre la détection d'une pluralité de configurations de cible différentes par une pluralité correspondante de seconds moyens de traitement de cible (174, 180, 182, 184).

54. Procédé d'acquisition de cibles optiques selon la revendication 53, dans lequel lesdites configurations de cibles différentes comprennent une configuration de cible rectangulaire et une configuration de cible circulaire.

55. Procédé d'acquisition de cibles optiques selon la revendication 48 dans lequel lesdits seconds moyens de traitement de cible (174, 180, 182, 194) comprennent des quatrièmes moyens de traitement de pré-reconnaissance (174) pour une détection préliminaire de ladite cible optique et des cinquièmes moyens de traitement de signaux numériques (180, 182, 194) pour une détection complémentaire de ladite cible optique, lesdits cinquièmes moyens de traitement de signaux numériques étant indépendants desdits quatrièmes moyens de traitement de pré-reconnaissance (174).

56. Procédé d'acquisition de cibles optiques selon la revendication 48, dans lequel une pluralité de transformées de cible différentes sont appliquées à une cible optique sélectionnée pour fournir une pluralité d'images de cible transformées, comprenant des moyens (240, 242) pour détecter une cible sélectionnée ayant une transformée de cible sélectionnée appliquée à ladite cible sélectionnée, comprenant les étapes supplémentaires suivantes :

(h) fournir une pluralité d'images modèles représentatives de ladite pluralité d'images de ci-

ble transformées ; et

(l) sélectionner une image modèle dans ladite pluralité d'images modèles en fonction de ladite transformée de cible sélectionnée.

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57. Procédé d'acquisition de cibles optiques selon la revendication 56 comprenant les étapes supplémentaires suivantes :

(j) comparer une image de cible transformée sélectionnée et ladite image modèle sélectionnée pour fournir ledit signal de détection ; et
(k) acquérir ladite cible transformée sélectionnée en fonction dudit signal de détection.

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58. Procédé d'acquisition de cibles optiques selon la revendication 56, comprenant en outre une surface de convoyage (20) permettant de disposer un objet (42) sur ladite surface de convoyage (20) pour balayer ledit objet avec des moyens d'image (50, 154) et traiter ledit objet (42) en fonction d'informations codées optiquement disposées sur ledit objet (42) dans lequel l'étape (i) comprend l'étape de sélection d'une image modèle en fonction de la distance entre lesdits moyens d'image (50, 154) et ledit objet (42).

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59. Procédé d'acquisition de cibles optiques selon la revendication 58, comprenant les étapes supplémentaires suivantes :

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(l) décoder lesdites informations codées disposées sur ledit objet en fonction des signaux provenant desdits moyens d'image (50, 154) ; et
(m) dévier ledit objet en fonction desdites informations décodées.

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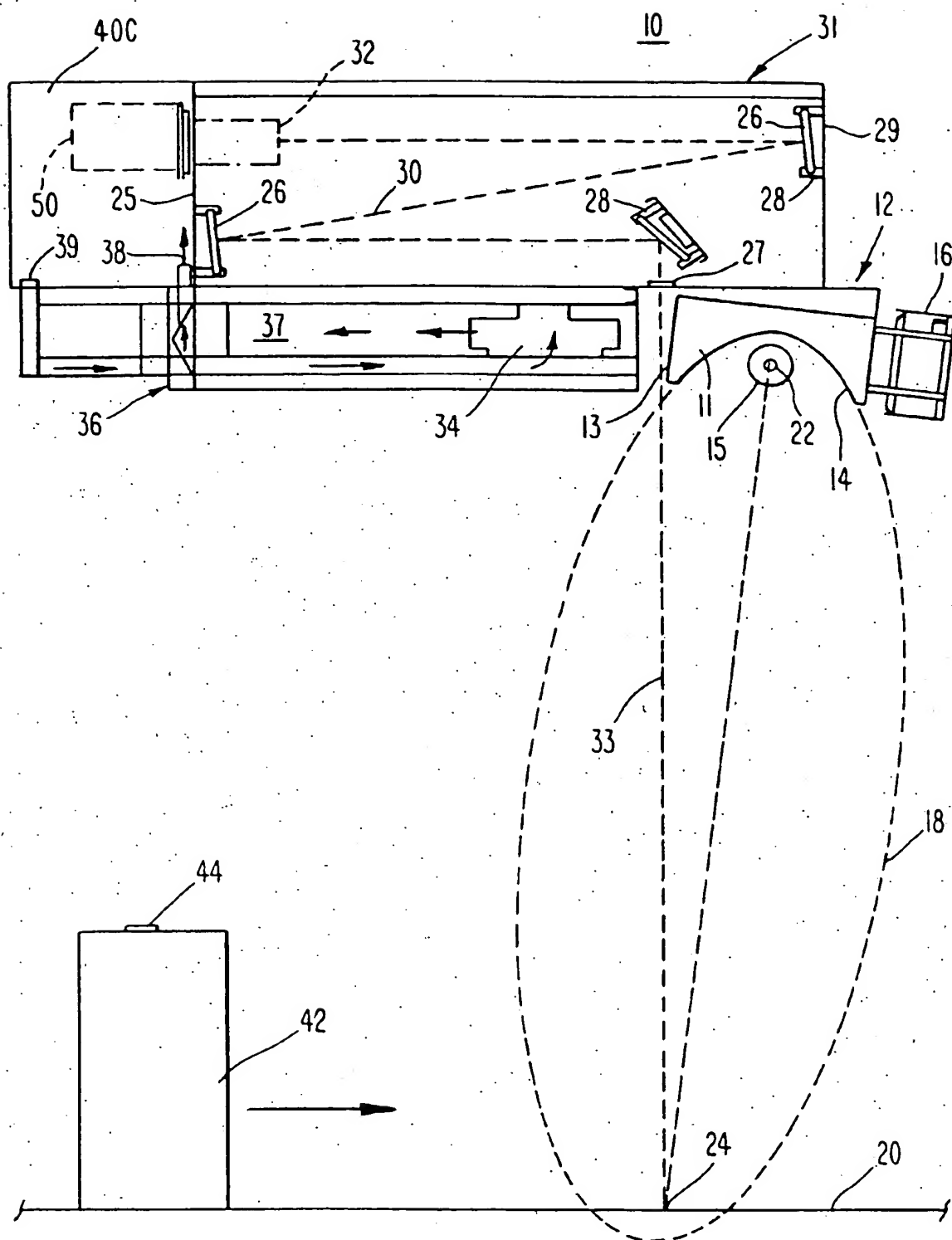


Fig. 1

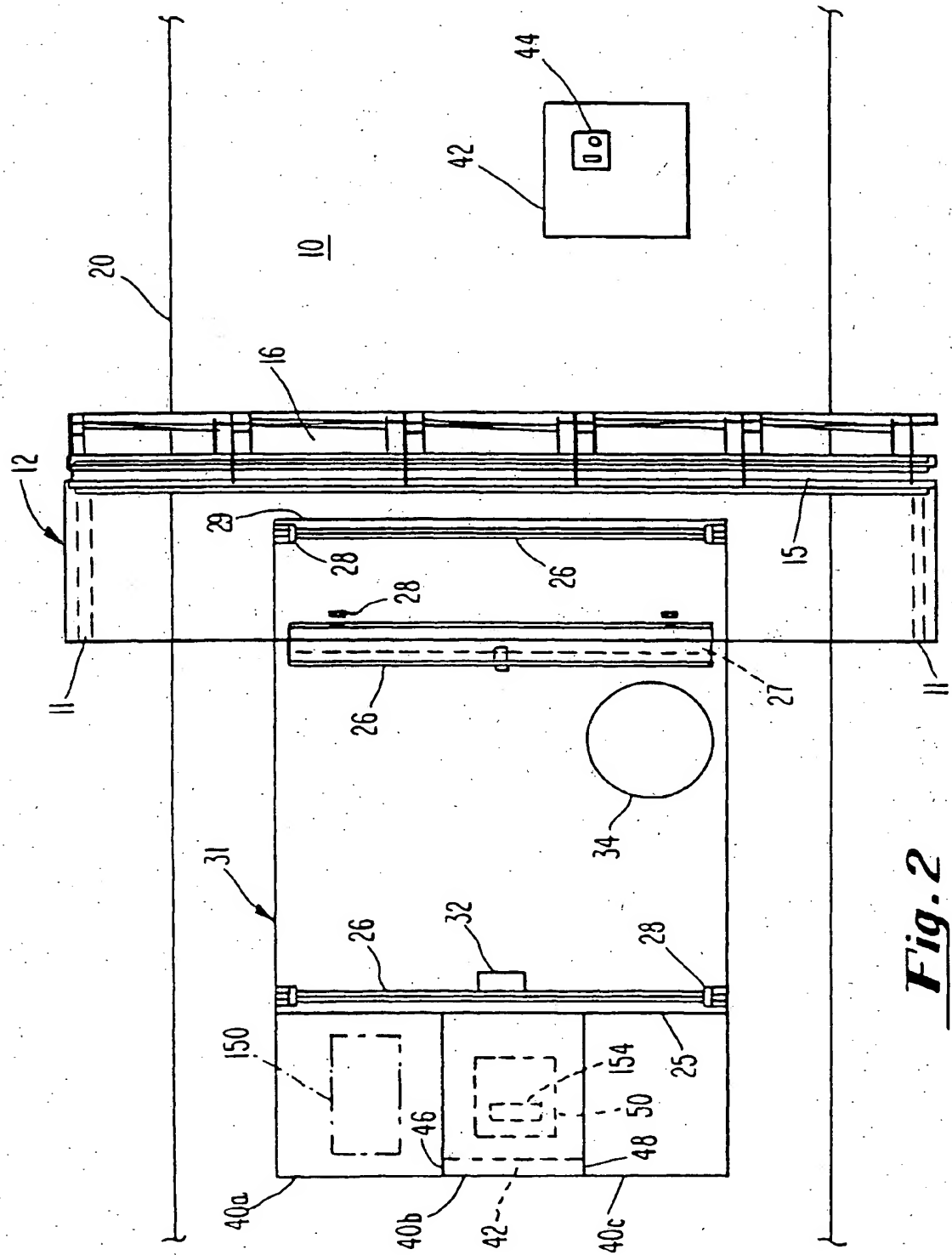


Fig. 2

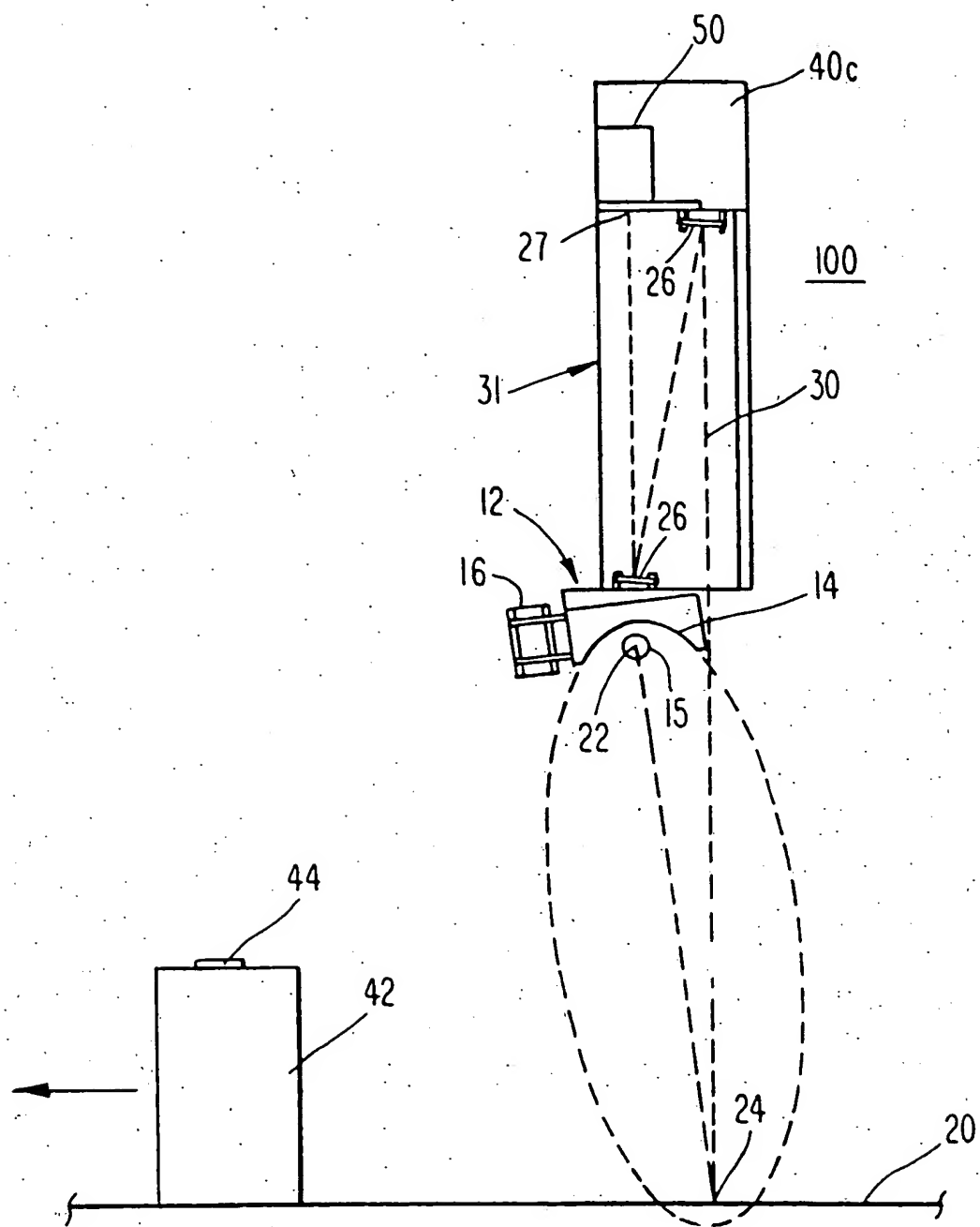
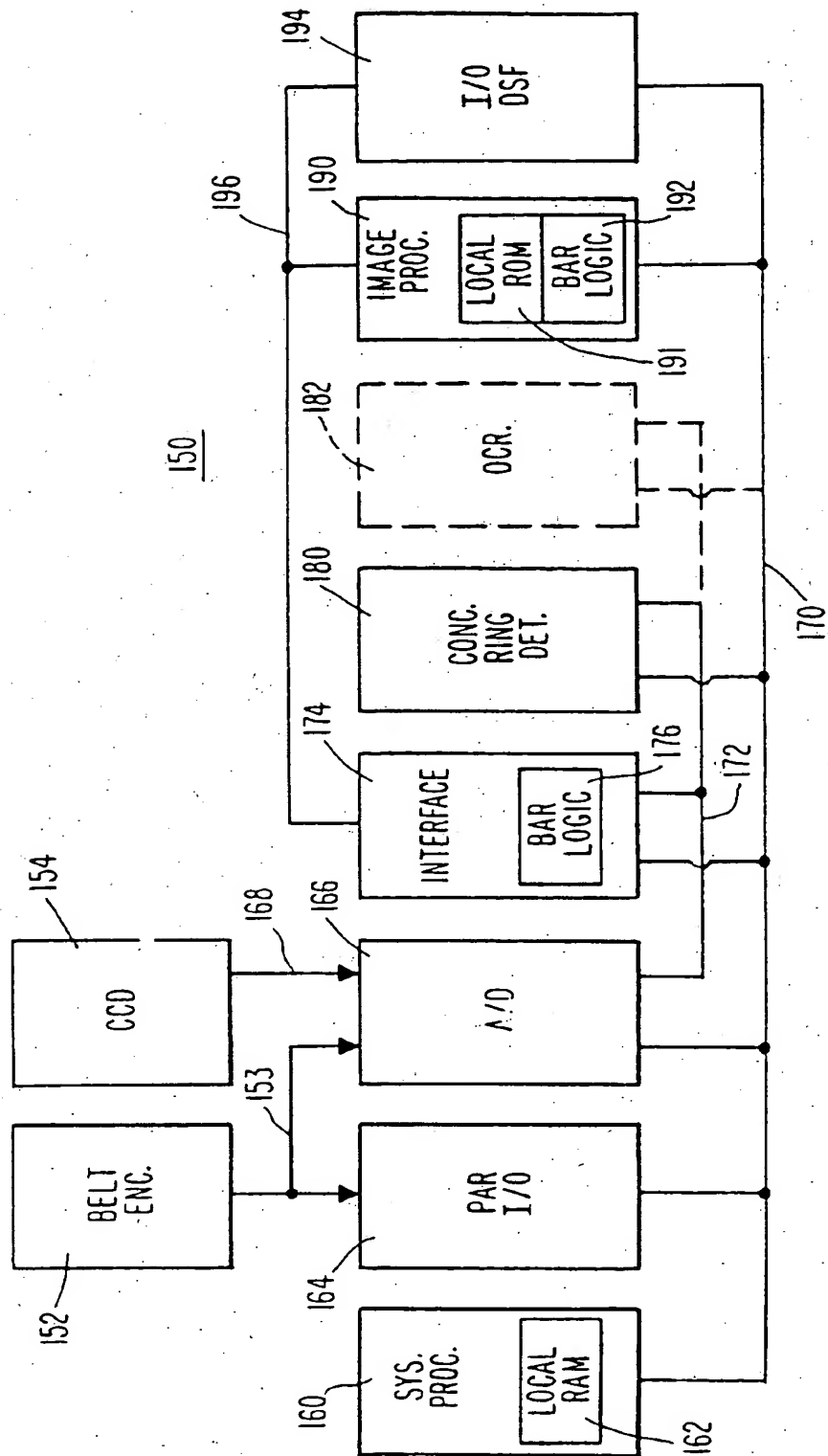
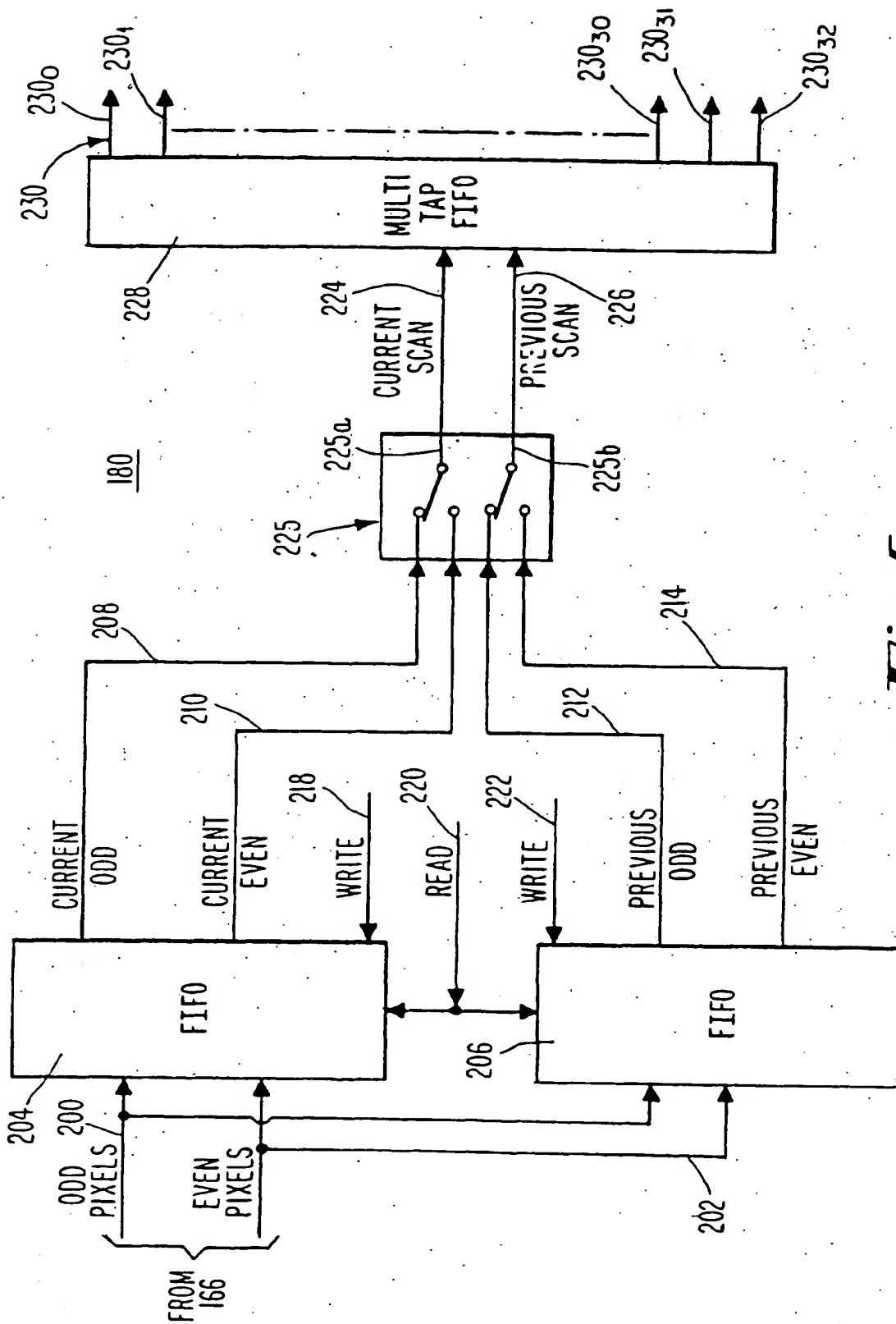


Fig. 3

**Fig. 4**

**Fig. 5**

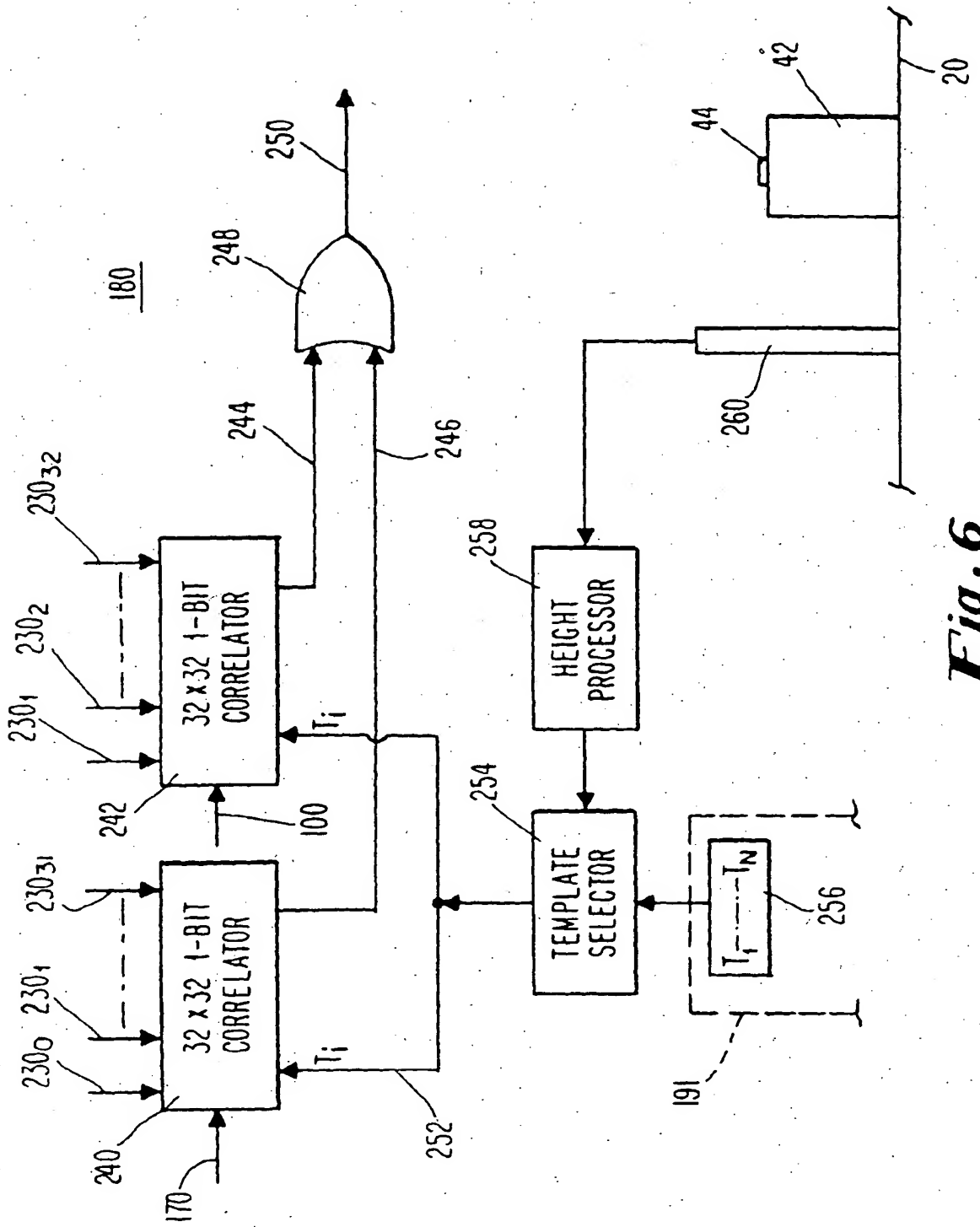


Fig. 6

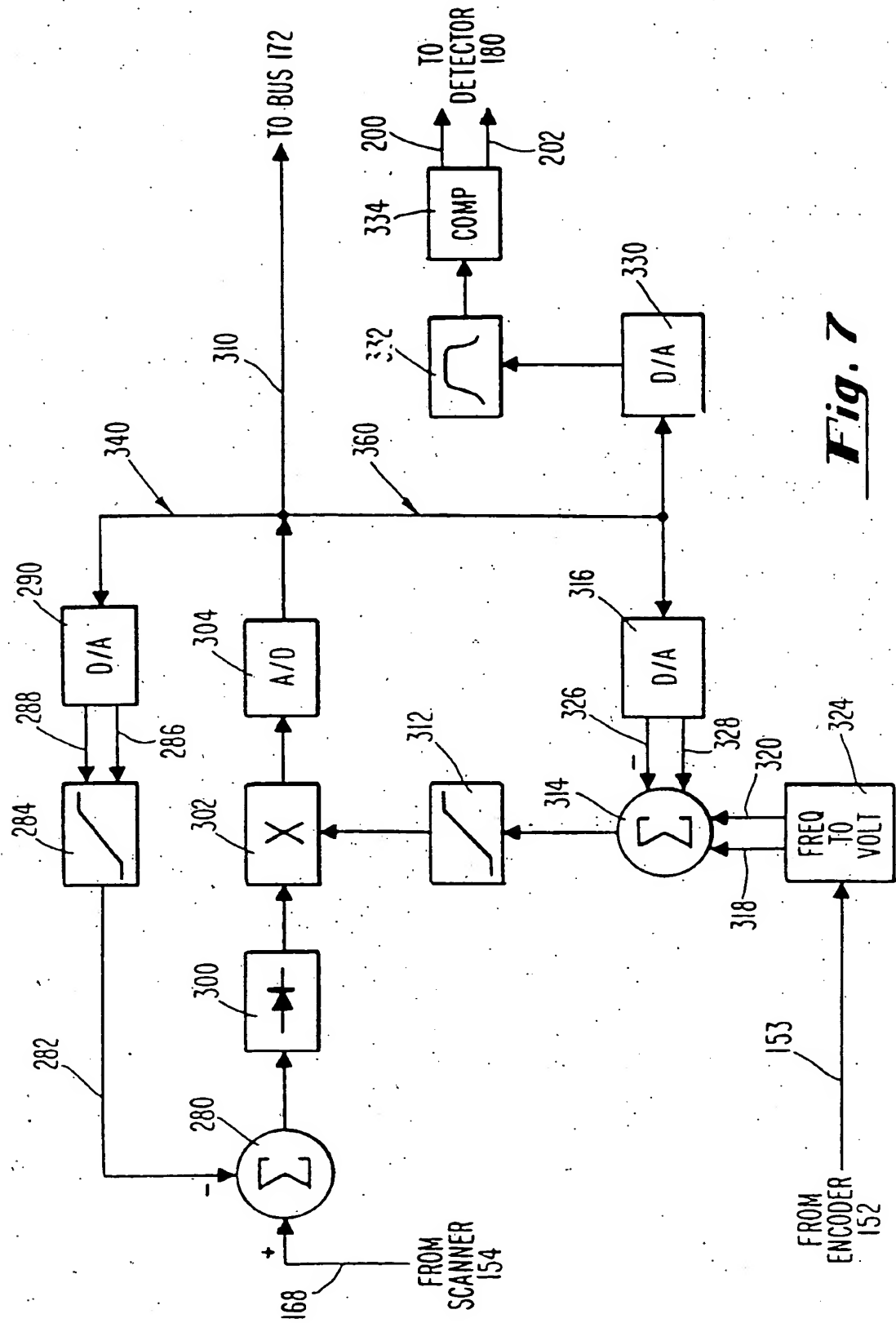


Fig. 7

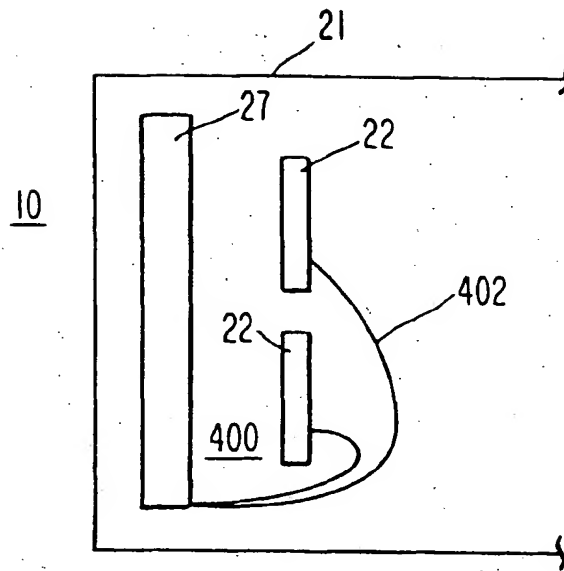


Fig. 8

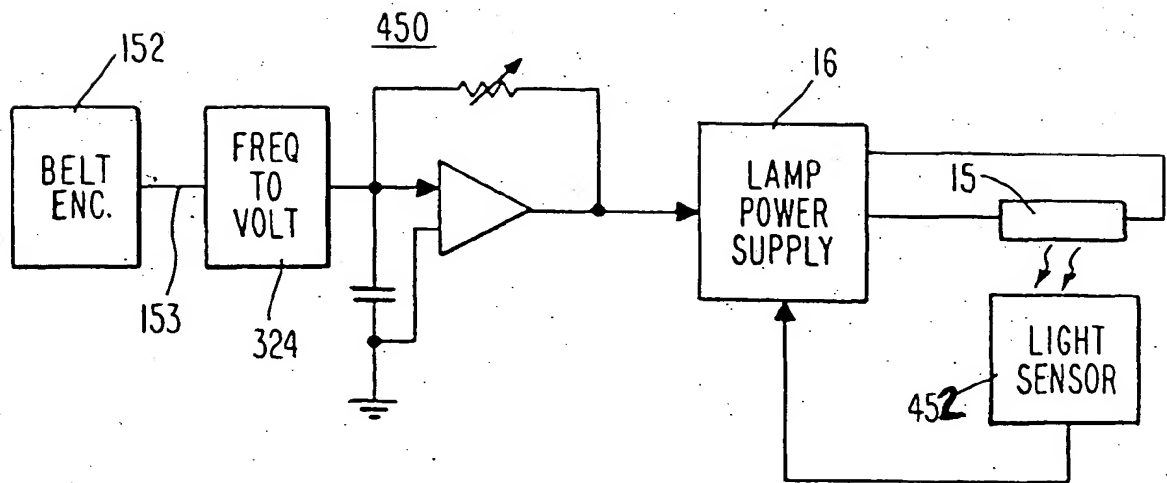
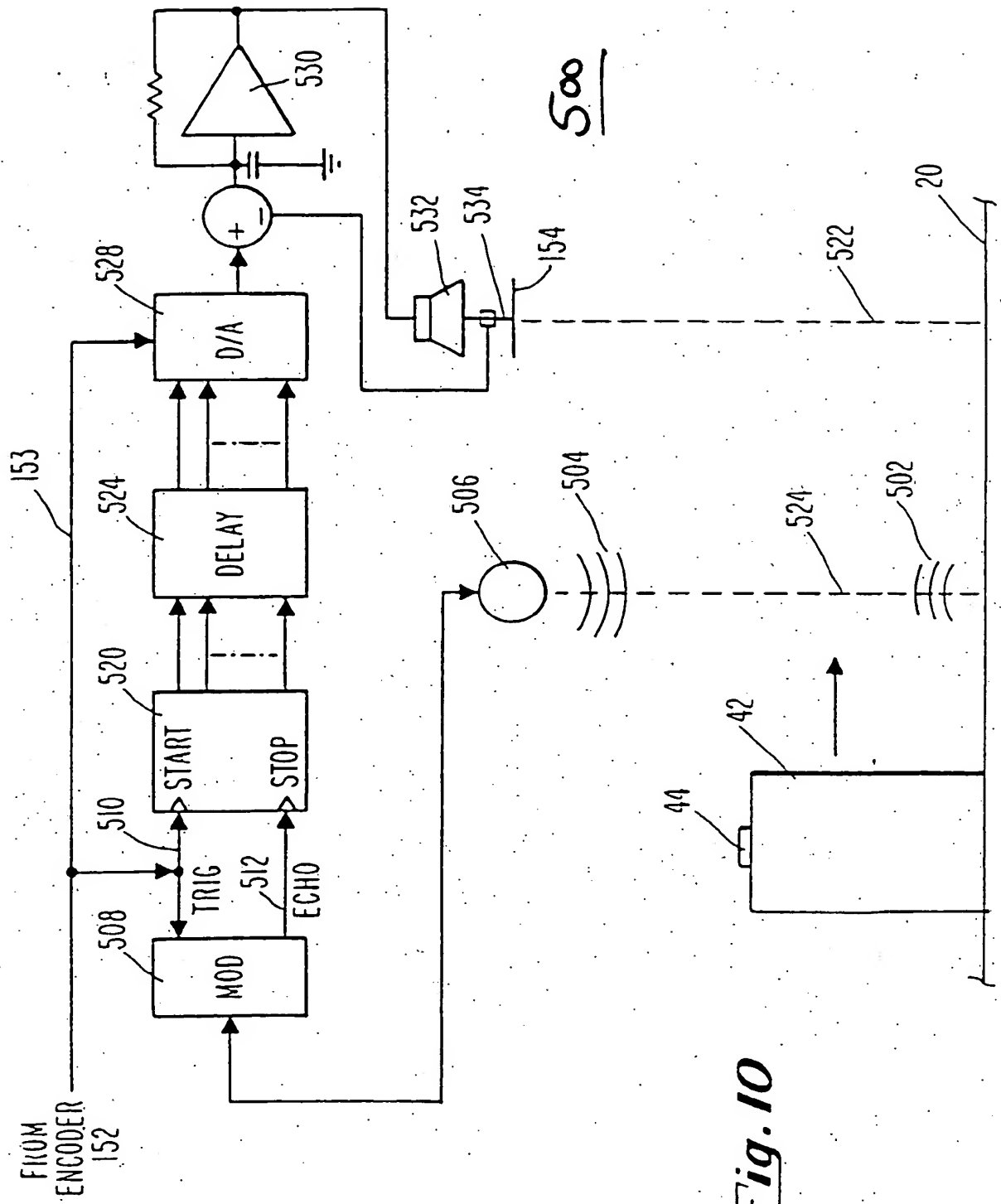


Fig. 9



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